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AN INTERNATIONAL JOURNAL FOR RESEARCH ON
TAXONOMY & NOMENCLATURE OF FUNGI, INCLUDING LICHENS

Volume LXIII June-August 1997

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ON PILODERMA BICOLOR AND THE CLOSELY RELATED P. BYSSINUM, P. CROCEUM, AND P. FALLAX

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ABSTRACT

We confirm an earlier conclusion that two species of mycorrhizal fungi, *Piloderma bicolor* and *P. byssinum*, are distinct and that the name *P. bicolor* has been correctly applied in North America. We also conclude that *P. fallax* is the most appropriate name for what has been called *P. bicolor* and *P. croceum*. Descriptions of the two species are supplemented with line drawings and photomicrographs.

INTRODUCTION

The genus *Piloderma* was introduced by Jülich (1968) to accommodate species originally included in *Corticium* sect. *Byssina* Bourd. & Galz. (Bourdot and Galzin, 1928) and typified by *Corticium bicolor* Peck. Species of *Piloderma* are reportedly ectomycorrhizal, particularly *P. bicolor* (Peck) Jülich [*Corticium bicolor* Peck (Peck, 1873)] (Eriksson *et al.*, 1981) and *P. byssinum* (Karst.) Jülich [*Lyomyces byssinus* Karst. (Karsten, 1884)] (Melin, 1936; Mikola, 1962; Vozzo, 1971; Froidevaux, 1975; Froidevaux and Jaquenoud-Steinlin, 1978; Harley and Smith, 1983).

The precise application of *P. byssinum* and *P. bicolor* was questioned earlier (Eriksson *et al.*, 1981; Larsen, 1983). Larsen (1983) objected to the new name, *P. croceum* Erikss. et Hjörts., proposed by Eriksson *et al.* (1981) to replace *P. bicolor*. Eriksson *et al.* (1981) concluded that *P. bicolor* had been applied consistently to a different species in Europe and was, therefore, a *nomen rejiciendum*. Furthermore, Eriksson *et al.* (1981) and Rogers and Jackson (1943) concluded that *P. bicolor* was synonymous with *P. byssinum*, and noted that *P. bicolor* had nomenclatural priority. Larsen (1983) concluded that the application of the name *P. bicolor* in North America was correct and that the species was distinguishable from *P. byssinum*. These views are also held by Jülich (1972), Gilbertson (1974), and Jülich and Stalpers (1980).

Stalpers (1984), after studying species of *Sporotrichum* Link., concluded that *P. (Sporotrichum) fallax* (Lib.) Stalp. is an earlier name for *P. croceum.* He (Stalpers) goes on to state that Libert's (1832) description of basidioma color ["primo aureis, tum sulphureis, demum albis" (at first golden yellow, then sulfur yellow, finally dull white - mjl)] excludes a possible synonymy with *P. byssinum.* Thus, the dispute over the identity of *P. byssinum* and its relationship to *P. bicolor* remains.

Our purpose here is to present results and conclusions based on the examination of nomenclatural types of the names in question and other specimens with regard to synonymy and criteria for separation of species. *Piloderma fallax* (syns. *P. bicolor, P. croceum*) is separated from *P. byssinum* by shape and size of spores and basidia, presence/absence of cystidioles, and color of cordons and subicula.

MATERIALS AND METHODS

Data on microscopical characteristics were obtained from small portions of basidiocarps squash-mounted in 5 percent KOH and stained with 1 percent Phloxine B or cotton blue (Johansen, 1940). Melzer's reagent (Melzer, 1924) was used to detect amyloid or dextrinoid structures. Capital letters used to designate herbaria are those of Holmgren *et al.* (1990). Color designations are those of Munsell (1929-1942). Photomicrographs were prepared with the aid of an Olympus Vanox-T photomicroscope utilizing Kodak T max 35 mm film. The contrast of Phloxine-B (spectral absorbance ca. 5100-5500 Å) stained structures was enhanced by a green filter (wave length emission ca. 5200 Å).

SPECIES DESCRIPTIONS

Piloderma fallax (Lib.) Stalp., Stud. Mycol. 24:53. 1984
≡ *Sporotrichum fallax* Lib., Plantae Cryptog. Ardennae; no. 187. 1832.
= *Corticium bicolor* Peck, Bull. Buffalo Soc. Nat. Sci. 1:62. 1873
≡ *Athelia bicolor* (Peck) Parm., Easti NSV Tead. Akad. Toim., Biol. 16:379. 1967.
≡ *Piloderma bicolor* (Peck) Jülich, Bericht. Deutsch. Bot. Ges. 81:417. 1969.
= *Piloderma croceum* Erikss. et Hjörts., Cort. N. Europe 6:1201. 1981.
= *Corticum croceum* Bres., Atti Accad. Sci. Lett. Art. Agiati Rov. 3:112. 1897, *non Corticum croceum* (Pat.) Sacc., Syll Fung. 11:124 1895 (= *Aleurodiscus croceus* Pat., Bull. Soc. Mycol. France 9:133. 1893).

Basidiomata effuse, up to 0.5 mm thick, occurring in small discontinuous patches or continuous, arachnoid to byssoid; **hymenial surface** smooth, usually distinctly pellicose, dull white to pale cream (near 7.5Y 8/4 TO 2.5Y 8/4); **cordons** saffron yellow (near 2.5Y 8/10) at first ["....under surface greenish yellow, upper surface white." (Peck, 1873 and see Libert's (1832) comments on color mentioned earlier)], eventually mostly dull cream but with some yellow to pale orange tints; **subiculum** saffron yellow (near 2.5Y 8/10) at first, fading to dull white with some parts pale dull yellow; **margin** concolorous with the subiculum, farinaceous to fimbriate.

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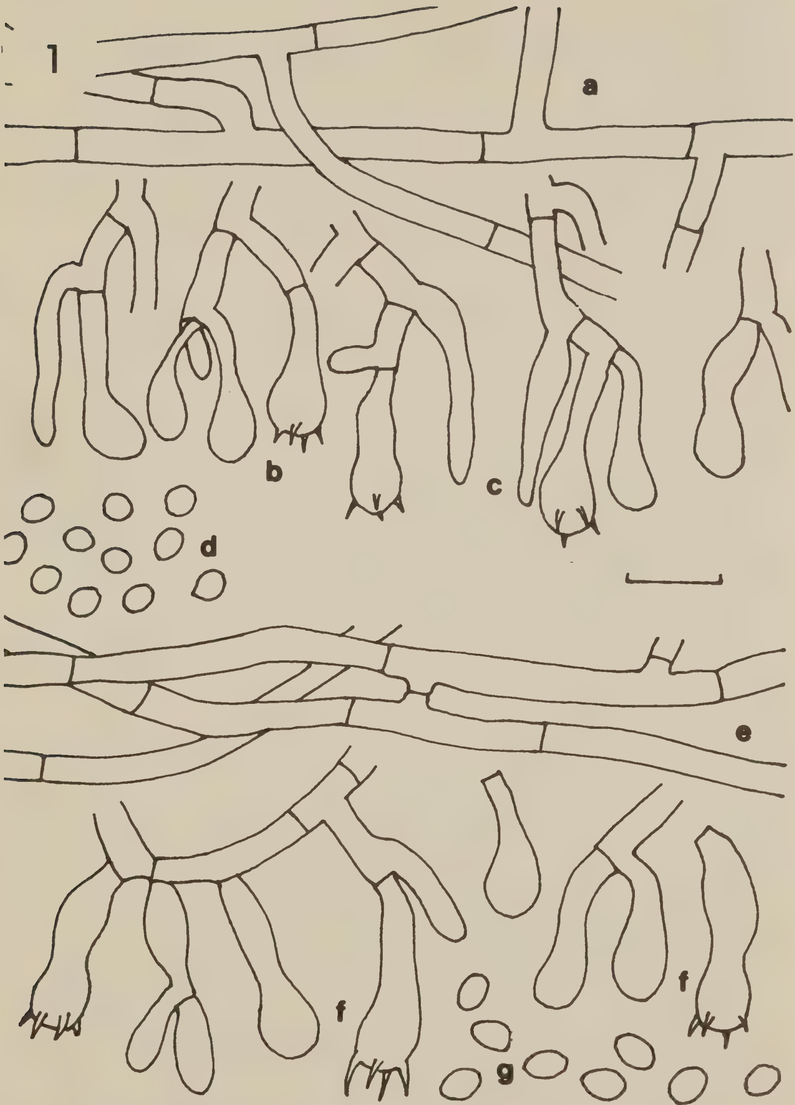


Fig. 1. Microscopical characteristics of *Piloderma fallax*. a: subicular hyphae; b: mature and immature basidia; c: cystidioles; d: basidiospores. *Piloderma byssinum*. e: subicular hyphae; f: mature and immature basidia; g: basidiospores (scale bar equal 10µm).

Hyphal system monomitic. ***Subicular hyphae*** 2-2.5 (-3) µm diam., septate without clamp connections, hyaline, thin-to somewhat thick-walled, often encrusted with variably shaped crystalline material; ***cordons*** 15-75 µm diam., individual hyphae as in subicular hyphae; ***subhymenial hyphae*** 2.5-3.5 µm diam., septate without clamp connections, hyaline, thin-walled; ***sterigmate basidia*** 12-15 x 3.5-4.5 µm, shape variable, sometimes appearing urniform or clavate, usually swollen apically and narrowed abruptly toward the base, septate without clamp connections at the base, hyaline, thin-walled,(2-) 4 (-6) -sterigmate; ***cystidioles*** frequent in most specimens, 10-13 x 2.5-3.5 µm, hyphoid to subulate, thin-walled, hyaline; ***basidiospores*** 2.5-3 (-3.5) x 2.5-3 µm, globose to subglobose, hyaline to pale yellow, usually thin-walled but some with thickened walls, faintly to intensely dextrinoid in Melzer's reagent, infrequently cyanophilous.

Specimens examined. ALASKA: Kenai Peninsula, south of Moose Pass, Trail Lakes campground, on *Betula papyrifera* Marsh., H. Burdsall, Jr. 12408, 13 Sept. 1988 (CFMR); Fairbanks, Steese Hwy. near Chaitaika River, under moss and *Picea mariana* (Mill.) B. S. P., B. Caldwell, 29 July 1995 (OSC). ARIZONA: Pima Co., Santa Catalina Mts., Coronado National Forest on *Pinus ponderosa* Laws., R.L. Gilbertson 9323, 31 Oct. 1969 (ARIZ; AN 003813). CALIFORNIA: 4 mi. east of Mendocino, on *Pseudotsuga menziesii ((*Mirb.) Franco, R.L. Gilbertson 13807, 16 Dec. 1984 (ARIZ; AN 003815). COLORADO: 4th of July Camp, Boulder Canyon, R.L. Gilbertson 4998, 21 Aug. 1964 (ARIZ; AN 003804). IDAHO: Kootenai Co., Kaniksu National Forest, north end of Priest Lake, M. Larsen 135931 and 135932, 23 Sept. 1995 (OSC), and J. Smith and D. McKay, T17855, 23 Sept. 1995 (OSC). MICHIGAN: Marquette Co., Huron Mountain Club, on *Tsuga canadensis* (L.) Carr., H. Burdsall, Jr. 9272, 28 Aug. 1976 (CFMR). MONTANA: Crane Mt., Mission Range, Flathead National Forest, on conifer wood, R.L. Gilbertson 4517, 29 June 1964 (ARIZ; AN 003799). North Fork Flathead River, on *P. ponderosa*, R.L. Gilbertson 4886 (ARIZ; AN 003801). NEW MEXICO: Los Alamos Co., Los Alamos, on *Populus tremuloides* Micht., R.L. Gilbertson 7383, 9 Aug. 1967 (ARIZ; AN 003809). NEW YORK: Karner (Center), on rotten wood, C.H. Peck no. 135 (Type of *Corticium bicolor*; NY); Warrensburg, on *Tsuga canadensis* (L.) Carr., C.H. Peck, Oct. 19 (NY; BPI, US0280466) [listed as *P. byssinum* in Jülich (1972)]; Minerva, Essex Co., on conifer wood, H.D. House, 6 Oct. 1931 (NY); Oneida, Madison Co., on fallen pine limbs, H.D. House, 25 Nov. 1918 (NY; BPI, US0280456) [listed as *P. byssinum* in Jülich (1972)]; Ringwood Preserve, Thompkins Co., hypogeous under *Fagus grandifolia* Ehrh., J. Trappe 5965, 30 Sept. 1980 (OSC). OREGON: Tillamook Co., Otis, Cascade Head Experimental Forest, among roots of *Picea sitchensis* (Bong.) Carr., J. Trappe 5667, 4 Dec. 1979 (OSC). WASHINGTON: Thurstan Co., Fort Lewis, on decayed *P. menziesii*, W. Colgan III T17278, 3 Nov. 1993 (OSC); Olympia, Fort Lewis, on decayed *P. menziesii*, W. Colgan III T17806, Jan. 1995 (OSC); Olympia, Fort Lewis, W. Colgan III T13246, 3 Nov. 1993 (OSC). BELGIUM: In *Fagetis* ad folia dejecta, truncos et radices herbarum muscorumque, autumno, Plantae Cryptog. Ardennae no. 187 (Type of *Sporotrichum fallax*; BR). NORWAY: Doure National Park, Sør-Trøndelag, on *Betula* sp., K. Hjörtstam 13605, 16/17 Aug. 1983 (OSC). SWEDEN: Småland, Almesåkra parish, on litter and decorticated wood of *Betula* sp., S. Lundell (3026) and G. Haglund, Fungi Exsicatti Suecici 1842 (Type of

Piloderma croceum; UPS, BPI); Småland, Värnamo, Björs, on *Pinus sylvestris* L., 2 Nov. 1959, Fungi Suecici 180 (ARIZ; AN 003789).

Piloderma byssinum (Karst.) Jülich, Ber. Deutsch. Bot. Ges. 81:418. 1968.
≡ *Lyomyces byssinus* Karst., Medded. Soc. Fauna Fl. Fenn. 11:137. 1884.
≡ *Tomentella byssina* (Karst.) Karst., Bidrag Kaenn. Finl. Nat. Folk 48:420. 1889.
≡ *Corticium byssinum* (Karst.) Mass., Linn. Soc. Bot. J. 27:133. 1890.
≡ *Athelia byssina* (Karst.) Parm., Easti NSV Tead. Akad. Toim. 16:380. 1967.

Basidiomata effuse, up to 0.4 mm thick, occurring in small patches, loosely attached, arachnoid to byssoid; **hymenial surface** smooth, arachnoid to pelliculose; fertile area dull white to pale cream (near 2.5Y 8/4); **subiculum and cordons** white (near 2.5Y 8/4); **margin** concolorous with the subiculum, farinaceous to fimbriate.

Hyphal system monomitic. ***Subicular hyphae*** 2.5-3 (-3.5) µm diam., septate without clamp connections, hyaline, usually encrusted with crystalline material of various shapes; ***cordons*** 15-30 µm diam., individual hyphae as in subicular hyphae; ***subhymenial hyphae*** 3.5-4 µm diam., hyaline, thin-walled, branching frequently; ***cystidioles*** not seen; ***sterigmate basidia*** 18-25 (-30) x 4-6 µm, mostly clavate but often with a narrow stem-like basal part and abruptly expanded apex, some appearing urniform, hyaline, staining in cotton blue, some dextrinoid in Melzer's reagent, 4-sterigmate; ***basidiospores*** 3.5-4.5 x (2.5-) 3-3.5 µm, ellipsoid to subglobose, thin-walled but some with thickened walls in KOH, usually cyanophilous, faintly dextrinoid in mass in Melzer's reagent after 2-3 hr exposure.

Specimens examined. ARIZONA: Mt. Bigelow, Santa Catalina Mts., Coronado Nat'l. Forest, on *Pinus ponderosa*, R.L. Gilbertson 9179, 16 Sept. 1969 (BPI; US0280535). COLORADO: Buckhorn area, Roosevelt Nat'l. Forest, on *Pinus murrayana* Grev. et Balf. in A. Murr. [≡ *Pinus contorta var. murrayana* (Grev. et Balf.) Engelm.] R. Davidson, 3 Oct. (BPI; US0279893). IDAHO: Priest River Experimental Forest, Priest River, M. Larsen 134612, 23 July 1981 (CFMR). MINNESOTA: Lake Itasca State Park, Clearwater Co., on *Picea glauca* (Moench) Voss, R.L. Gilbertson 9738, 18 Aug. 1970 (BPI; US0299931). OREGON: Benton Co., Woods Creek near Mary's Peak watershed gate, under *P. menziesii*, J. Trappe and L. Froideveaux, Trappe no. 3599, 17 Jan. 1973 (OSC). FINLAND: Nylandia, Mjölö (=Isosaari), E. Wainio, Karsten 681, Oct. 1883 (Type of *Lyomyces byssinus* (H); Tarastia australis, Tammela, Mustiala, in ligno *Pinus sylvestris* L., P.A. Karsten 680, 29 Oct. 1888 (H), and Syrjä, (Mustiala W), ad *Abietem*, P.A. Karsten, Nov. 1883. SWEDEN: Småland, Femsjö, very rotten coniferous wood, S. Lundell 1580, 13 Sept. 1939, Fungi Exsiccati Suecici 1033a (BPI); Småland, Femsjö, Stenekullarna, J. Johnsson and S. Lundell, 6 Oct. 1939, Fungi Exsiccati Suecici 1033b (BPI).

DISCUSSION AND CONCLUSIONS

Our observations indicate that *Piloderma fallax*, *P. croceum*, and *P. bicolor* represent the same species and is distinguishable from *P. byssinum*. The principle criteria for the separation of species is provided in Table 1.

Table 1. Summary of criteria for separation of *Piloderma fallax* and *P. byssinum*

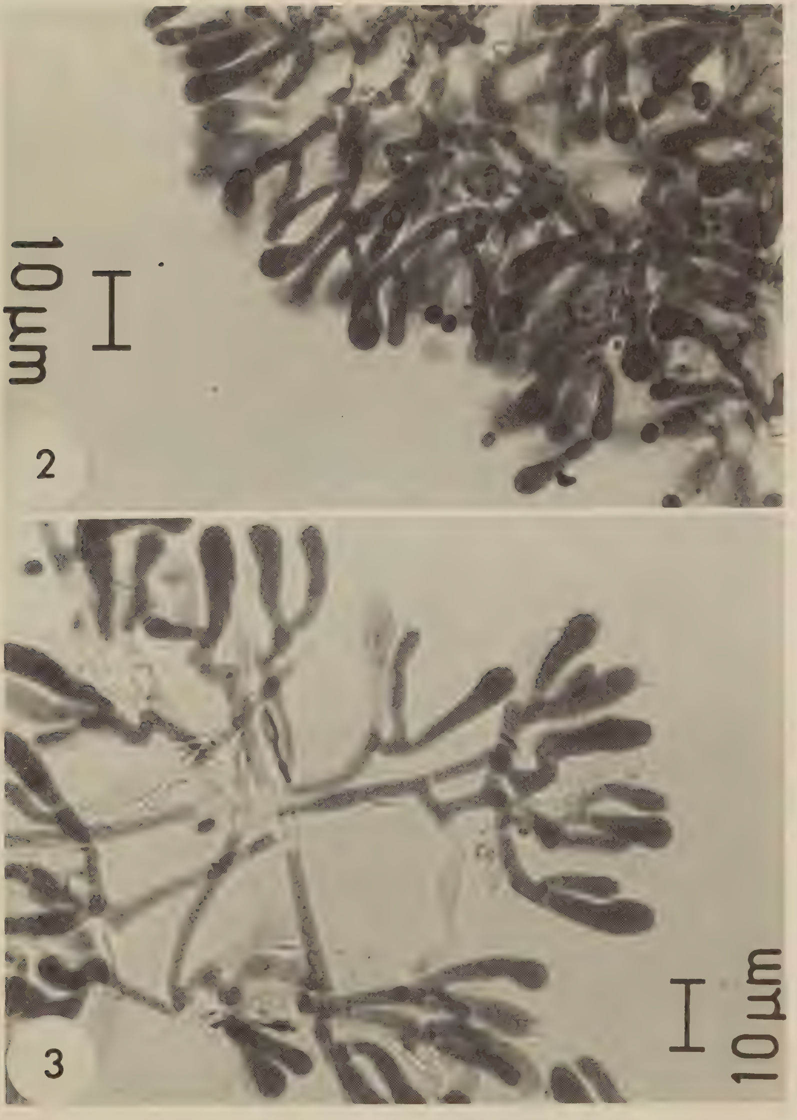
	P. fallax	*P. byssinum*
Basidiospore size	2.5-3 (-3.5) x 2.5-3 µm	3.5-4.5 x (2.5-) 3-3.5 µm
Basidiospore shape	Globose to subglobose	Ellipsoid to subglobose
Basidial size	12-15 (-18) x 3.5-4.5 µm	(13-) 15-21 (-25) x 4-6 µm
Cystidioles	Usually present, subulate to hyphoid	Absent
Color of rhizomorphs and subiculum	Saffron yellow when fresh, frequently fading upon drying	Dull white when freshand remaining so upon drying

The pigmentation, or lack thereof, of cordons and subicula appears to be a reliable field character for species recognition, especially for *P. fallax*. Microscopical characters also appear to be useful, particularly dimensions of basidia which are somewhat larger in *P. byssinum*. The frequent occurrence of cystidioles in *P. bicolor* may also be helpful. Basidiospores of both species are similar in shape and dimension and may not be a useful diagnostic aid for most observers.

Staining responses of basidiomata to chemotaxonomic reagents (Melzer's reagent or cotton blue) have proven to be unreliable criteria. In both *P. fallax* (= *P. croceum, P. bicolor*) and *P. byssinum*, our observations showed that cyanophilly and responses to Melzer's reagent were inconsistent in the same basidioma or between basidiomata. Our observations are in conflict with some reports in the literature. Eriksson *et al.*(1981) note that spores are non-cyanophilous and somewhat dextrinoid for *P. croceum*, while Gilbertson (1974, re *Athelia bicolor*) and Jülich (1972, re *P. bicolor*) report negative responses (non-amyloid and presumably non-dextrinoid) in Melzer's reagent.

LITERATURE CITED

BOURDOT, H., AND A. GALZIN. 1928. Hyménomycètes de France. Paris. 761 pp.
ERIKSSON, J., K. HJÖRTSTAM, AND L. RYVARDEN. 1981. The Corticiaceae of north Europe (*Phlebia-Sarcodontia)* 6:1048-1276.
FROIDEVAUX, L. 1975. Identification of some Douglas fir mycorrhizae. Europ. J. Forest Path. 5:212-216.


10 µm
2
3
10 µm

Figs. 2-3. Immature and mature sterigmate basidia of *Piloderma fallax* (Fig. 2) and *P. byssinum* (Fig. 3).

FROIDEVAUX, L., AND M. JAQUENOUD-STEINLIN. 1978. Les Hyménomycètes résupinés mycorrhiziques dans le bois pourri. Schweiz. Zeitschr. f. Pilzk. 56:9-14.
HARLEY, J. L., AND S. E. SMITH. 1983. Mycorrhizal symbiosis. Academic Press, London. 483 pp.
HOLMGREN, P. K., N. H. HOLMGREN, AND L. C. BARNETT. 1990. Index Herbariorum. Part I. The herbaria of the world. Reg. Veget. 120:1-693.
JOHANSEN, D.A. 1940. Plant microtechnique. McGraw-Hill Book Co., New York, London. 523 pp.
JÜLICH, W. 1972. Monographie der Atheliae (Corticiaceae, Basidiomycetes). Wildenowia 7:1-283.
JÜLICH, W., AND J. A. STALPERS. 1980. The resupinate non-poroid Aphyllophorales of the temperate northern hemisphere. Verhand. Konink. Nederl. Akad. Vetensch. Naturk. 74:1-335.
KARSTEN, P. A. 1884. Fungi rariores Fennici atque non nulli Sibirici a Dire Edv. Vainio lecti. Meddel. Soc. Fauna Fl. Fenn. 11:136-147.
LARSEN, M. J. 1983. On *Piloderma bicolor* in North America and its relationship to *Piloderma byssinum*. Mycologia 75:1092-1093.
LIBERT, M. A. 1832. Plantae Cryptog. Ardennae, no. 187.
MELIN, E. 1936. Methoden der experimentellen untersuchungen mykotropher Pflanzen. Handb. Biol. Arbeitsmeth. 11:1015-1108.
MELZER, V. 1924. L'ornamentation des spores des *Russules*. Bull. Soc. Mycol. France 40:78-81.
MIKOLA, P. 1962. The bright yellow mycorrhiza of raw humus. Proc. Int. Union Forest. Res. Organ., 13th Congress. No. 24-4. 14 pp.
MUNSELL COLOR COMPANY. 1929-1942. Munsell Book of Color. Munsell Color Co., Inc., Baltimore, Md.
PECK, C. H. 1873. V. Descriptions of new species of fungi. Hymenomycetes. Bull. Buffalo Soc. Nat. Sci. 1:41-72.
ROGERS, D. P., AND H. S. JACKSON. 1943. Notes on the synonymy of some North American Thelephoraceae and other resupinates. Farlowia 1:263-328
STALPERS, J. A. 1984. A revision of the genus *Sporotrichum*. Stud. Mycol. 24:1-105.
VOZZO, J. A. 1971. Field inoculations with mycorrhizal fungi. Ed., E. Hacskaylo. *In*, Mycorrhizae: Proc. 1st. North Amer. Conf. Mycorrhizae, April 1969. USDA Forest Service Misc. Publ. 1189. pp. 187-196.

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NEW SPECIES AND NEW RECORDS OF ASCOMYCETES ON STEMS OF EUCALYPTS FROM TASMANIA, AUSTRALIA[1]

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SUMMARY

Five new species of ascomycetes collected on stems of eucalypts in Tasmania are described and illustrated. They are *Bertia antennaroidea* sp. nov., *Cryptodiaporthe curvata* sp. nov., *Diaporthe fusispora* sp. nov., *Phomatospora macrospora* sp. nov. and *Wuestneia campanulata* sp. nov.. Morphological differences and similarities of these new species are compared with closely related taxa. *Coniochaeta pulveracea, Eutypa spinosa, Fenestella media* and *Karstenula ceanothi* are recorded for the first time from Australia.

INTRODUCTION

In Australia, very little attention has been given to stem fungi, particularly the ascomyceteous fungi on eucalypts. Based on Sankaran *et al*. (1995), a few ascomyceteous species were recorded on stems of eucalypts, in contrast to a large number of fungi found on leaves. During a survey of fungi associated with stem and branch cankers of eucalypts in Tasmania, several of the ascomycetes collected were found to be undescribed or recorded for the first time in Australia. In the present paper, five of them are presented as new species and four as new records for Australia.

Microscopic examination of each specimen was carried out on squash mounts and thin median sections. The material was mounted in Shear's mounting fluid and lactophenol cotton blue. Fifty mature ascospores were measured for each fungal species, and arithmetic means calculated.

The holotypes and other specimens are deposited in the Herbarium of the Institute for Horticultural Development, Knoxfield, Australia (VPRI).

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[1] Part of a PhD research project for the senior author in the University of Tasmania

DESCRIPTION AND DISCUSSION

Bertia antennaroidea Z.Q. Yuan sp. nov.

Figs. 1, 2, 11, 12, 27 & 28

Etymology: refers to the dark subicle of the fungus.

Ascomata perithecialia, superficialia, discreta vel dense gregaria, sphaerica, 250-500 µm diam, nigra, tuberculosa, nonostiolata, in subiculo insidentia, subiculo e hyphis ramosis, septatis, brunneis ad atrobrunneis composito. Peridium 35-65 µm crassum, cellulis pseudoparenchymatis, brunneis, crassitunicatis, 7-25 µm diam compositum. Asci 100-125 x 10-14 µm, clavati vel subcylindracei, leptodermi, cum annulis apicalibus refractis, inamyloideis, octospori. Ascosporae 27.5-37.5 x 4.5-7.0 µm, biseriatae vel raro oblique uniseriatae, hyalinae, elongati-ellipsoideae, uni-septatae, rectae vel curvatae, ad septum leviter constrictae, glabrae, e gelatina tenuibus cingulatae.

Holotypus in ramulis mortuis *Eucalypti ovati* Labill., Welcome River, Smithton, Tasmania, 12 Dec. 1995, *Z.Q. Yuan & M. Hall* WC37a (VPRI 21064)

Ascomata perithecioid, superficial, separate to densely gregarious, seated on a subiculum composed of brown to dark brown septate and branched hyphae, black; the outer surface conspicuously marked with coarse warts, without ostioles, spherical, 250-500 µm diam. Peridium 35-65 µm wide, of dark, large, thick-walled pseudoparenchymatous cells, 7-25 µm in diam. Asci 100-125 x 10-14 µm, clavate to subcylindrical, short stalked, thin-walled, with a nonamyloid apical ring, 8-spored. Ascospores 27.5-37.5 x 4.5-7.0 (mean 35 x 6.0) µm, biseriate at the upper parts or obliquely monoseriate, hyaline, 1-septate, elongated ellipsoid, straight or curved, slightly constricted at the septum, smooth-walled, surrounded with a thin mucilaginous sheath.

On dead stems or decorticated branches of *Eucalyptus* spp.

Specimens examined: Tasmania, Welcome River, Smithton, on *E. ovata*, 12 Dec. 1995, *Z.Q. Yuan & M. Hall* WC37a (VPRI 21064, Holotype); Florentine Valley, Westfield, on *Eucalyptus regnans* F. Muell., 13 July 1995, *Z.Q. Yuan* 39 (VPRI 21065); Jacky Marsh Rd, Poatina, on *E. amygdalina* Labill., 6 Dec. 1995, *Z.Q. Yuan & M. Hall* ET34 (VPRI 21066); Woolnorth, on *E. globulus* Labill., 17 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W11a (VPRI 21067); West Ridgley, on *E. nitens* (Deane & Maiden) Maiden, 16 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W22a (VPRI 21068).

This new species can be easily separated from others of *Bertia* by the unique presence of subicules at bases of ascomata, its asci with apical rings and

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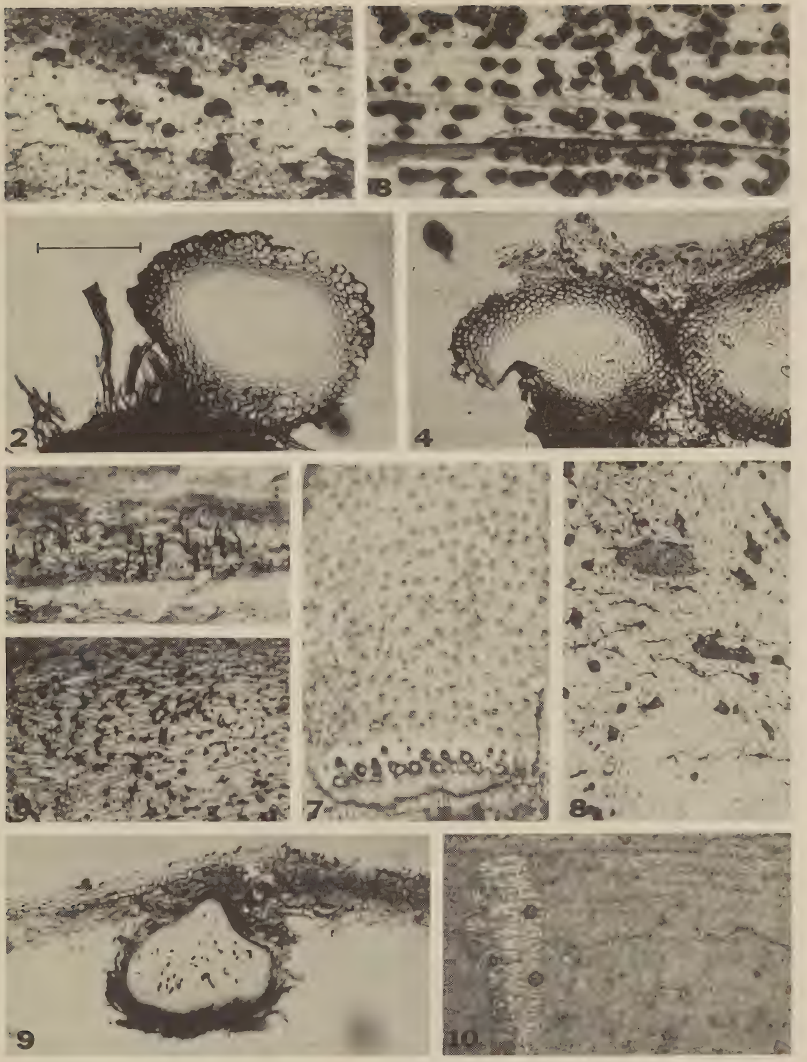
(VPRI 20830); **Fig. 9**: *Karstenula ceanothi*, Vertical section of ascoma (WC66a); **Fig.10**: *Phomatospora macrospora,* Ascomata immersed in bark (W11b) (Bar = 120 µm for Figs.2 & 4; = 240 µm for Fig.9; = 2 mm for Fig.3; = 3 mm for Figs.1 & 10; = 4 mm for Figs.5 & 6; = 5 mm for Fig.7; = 6 mm for Fig.8)



Figs.1-2: *Bertia antennaroidea*. **Fig.1**. Ascomata on stem (W22a); **Fig.2**. Vertical section of ascoma with basal hyphal subiculum (Holotype); **Fig.3**.: *Coniochaeta pulveracea*. Ascomata on stem; **Fig.4**: *Cryptodiaporthe curvata*. Vertical section of ascomata showing peridium (W20); **Figs 5-6**: *Diaporthe fusispora*. **Fig.5**. Ascomata on stem (Holotype), **Fig.6** Ascomata on stem(W22d); **Fig.7**: *Eutypa spinosa*. Ascomata on stem (WC56); **Fig.8**: *Fenestella media*. Ascomata immersed in bark

←

ascospores which are always 1-septate, constricted at the septum and surrounded by a thin gelatinous sheath.

The presence of hyphal subicules at ascoma base and the gelatinous sheaths surrounding ascospores in *B. antennaroidea* are features which have not been observed previously in any known species of *Bertia* (Munk, 1957; Corlett & Krug, 1984; Subramanian & Sekar, 1990; Hsieh *et al.*, 1995; Hyde, 1995), although Krug & Corlett (1988) found a black basal subicule-like crust in *B. sinensis* Krug & Corlett and geniculate ascospores.

Presence of the subicule in *B. antennaroidea* might suggest affinity to *Calyculosphaeria* Fitzpatrick. The latter genus, however has small, fusiform, 1-septate ascospores and has been included as a synonym in *Nitschkia* Otth. (Hawksworth *et al.*, 1995).

Only one species in *Bertia*, *B. convolutispora* K.D. Hyde, described from submerged wood in streams, has been recorded in Australia (Hyde, 1995). *B. antennaroidea* has little in common with that species, except for the presence of ascal apical rings.

Coniochaeta pulveracea (Ehrh. : Fr.) Munk, Dansk Bot. Ark. 17: 90. 1957

Figs.3, 19 & 31

Ascomata perithecioid, superficial, gregarious, broadly ovate to subglobose, 200-300 µm wide, 250-350 µm high, ostiolate, glabrous, with pale brown hyphae at the base. Peridium up to 45 µm thick, composed of dark thick-walled pseudoparenchymatous cells. Asci 80-110 x 10-13 µm, cylindrical, obtuse to truncate at apex, 8-spored. Ascospores 10-13 x 7-8 µm, ellipsoid to broad ellipsoid, brown to dark brown, smooth-walled, with a longitudinal germ slit.

On dead stems of eucalypts.

Specimen examined: Tasmania, Ben Ridge, St. Helens, on *Eucalyptus delegatensis* R. Baker, 5 Dec. 1995, *Z.Q. Yuan & M. Hall* ET25a (VPRI 20829).

The morphology of this fungus on eucalypt is also close to that of *C. ligniaria* (Grev.) Cooke. The latter differs from *C. pulveracea* in its perithecia covered with setae and in having slightly large ascospores (*fide* Munk, 1957; Mahoney & LaFavre, 1981). Several species of the genus *Coniochaeta* have been recorded previously in Australia (Hawksworth & Yip, 1981).

Cryptodiaporthe curvata Z.Q. Yuan sp. nov.

Figs.4, 17, 18, 32 & 33

Etymology: refers to the curved ascospores.

Ascomata immersa, singula vel gregaria in catervatim 2-4, cum stromatico prosenchymatico, criter evoluto et in texto plantae promiscuo. Perithicia sphaerica vel ad basim applanata, 250-350 µm lata, 250-400 µm alta, nigra, ostiolo periphysato. Peridium 40-50 µm crassum, pseudoparenchymaticum, ex cellulis parietibus fuscis, crassitunicatis, 10-20 µm diam compositum. Asci 62.5-87.5 x 12.5-17.5 µm, unitunicati, clavati, apice incrassati, cum annulis apicalibus refractis inamyloideis, octospori. Ascosporae 20-35 x 5-7.5 µm, oblique vel irregulariter biseriatae, hyalinae, oblong-ellipsoideae vel cylindraceae, demum rotundatae, uniseptatae, ad medium constrictae, inequilaterales, e gelatina tenuibus cingulatae.

Holotypus in ramulis mortuis *Eucalypti delegatensis*, Seed orchard, Ridgley, Tasmania, 16 April 1996, *Z.Q. Yuan* W20b (VPRI 21069)

Ascomata immersed, developing singly or in clusters of two to four within the periderm, appearing on the surface as numerous minute, papillate pustules. Stromatic tissue prosenchymatous, poorly developed, mixed with the host tissue. Perithecia spherical or with flattened bases, 250-350 µm wide, 250-400 µm high, black; ostiole lined with periphyses. Peridium 40-50 µm wide, consisting of several layers of dark, thick-walled rounded pseudoparenchymatous cells, 10-20 µm diam. Asci 62.5-87.5 x 12.5-17.5 µm, unitunicate, clavate, with a tapering base, with nonamyloid refractive rings at a thickened apex, 8-spored. Ascospores 20-35 x 5-7.5 µm, obliquely or irregularly biseriate in the ascus, hyaline, oblong-ellipsoid to cylindrical, rounded ends, with one median septum, slightly constricted at the middle, inequilateral, surrounded by a thin gelatinous sheath.

On dead stems of eucalypts.

Specimens examined: Tasmania, Seed orchard, Ridgley, on *E. delegatensis*, 16 April 1996, *Z.Q. Yuan* W20b (VPRI 21069, Holotype); same location and host, 16 April 1996, *Z.Q. Yuan* W21 (VPRI 21070).

Overall none of the previously known species of *Cryptodiaporthe* fits well with the new species. The scattered and immersed ascomata with poorly developed stromata in *C. curvata* are similar to those of *C. aubertii* (West.) Wehmeyer and ascospore size close to that of *C. magnispora* (Ell. & Ev.) Wehmeyer. However the latter species has even larger, ellipsoid to fusoid non-constricted ascospores (35-40 x 7-9 µm, *fide* Wehmeyer 1933). The only species closer to the new species in ascospore size and shape is *C. salicella* (Fr.) Petr., which has ascospores measuring 14.2-27.8 x 4.4-7.7 µm (*fide* Mathiassen, 1993). Although, as illustrated by Mathiassen (1993), quite a few of the ascospores of *C. salicella* in type material are oblong-ellipsoid with rounded apices and often slightly bent as in *C. curvata*, the constriction at the middle of the ascospores appears to be a unique character of the new species.

The inequilateral, oblong-ellipsoid to cylindrical ascospores with narrower middles of *C. curvata* may suggest affinity with *Vialaea* Sacc.. However, species of *Vialaea* have ascomata scattered singly without stromatic tissue and asci with amyloid apical rings. Ascospores of *Vialaea* are strongly constricted in the middle (propeller-shaped) and the genus was included in the Amphisphaeriaceae by Müller & Arx (1973). Cannon (1995) re-studied the genus *Vialaea* and established the family Vialaeaceae to accommodate this genus

No species of the genus *Cryptodiaporthe* has been recorded previously on eucalypts (Sankaran *et al*., 1995). Recently a species, *C. melanocraspeda* Bathgate, Barr & Shearer was described on *Banksia coccinea* R. Br. from western Australia but it has little in common with *C. curvata* (Bathgate *et al*., 1996).

Diaporthe fusispora Z.Q. Yuan sp. nov.

Figs. 5, 6, 15, 16 & 30

Etymology: refers to the fusoid ascospores.

Ascomata discreta, laxe immersa in pseudostromate marginali nigrofacto, sphaerica vel sphaeroidea, 225-300 µm lata, 200-250 µm alta, collis 600-900 µm altis, basi 100-120 µm et apice 60-80 µm diam. Peridium 17-22 µm crassum, ex cellulis compressis compositum. Asci 37.5-43 x 7.5-10 µm, clavati, cum annulis apicalibus, refractis inamyloideis, octospori. Ascosporae 10-15 x 3-5 µm, superimposite biseriatae, hyalinae, fusoideae vel raro elliptic-fusoideae, rectae vel leviter curvatae, 1-septatae, ad septum constrictae, cum appendicibus 1-1.5 µm longis, setaceis, delicatis in quoque extremo ascosporae, 4-guttulatae.

Holotypus in ramulis *Eucalypti globulus*, West Ridgley, Tasmania, 16 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W15 (VPRI 21071)

Ascomata separate or loosely clustered, immersed beneath a dorsal zone along a blackened bark surface, globose or subglobose, 225-300 µm wide, 200-250 µm high; beak protruding through bark, 600-900 µm high and 100-120 µm diam at base, 60-80 µm at apex. Peridium 17-22 µm wide, composed of several layers of compressed cells. Asci 37.5-43 x 7.5-10 µm, clavate, with nonamyloid refractive apical rings, 8-spored. Ascospores 10-15 x 3-5 (mean = 12 x 4.2) µm, overlapping biseriate, hyaline, fusoid, sometimes elliptic-fusoid, straight or slightly curved, with 1 median septum, constricted at the septum, bearing a delicate setose appendage at each end, 1-1.5 µm long; 4-guttulate.

On stems of eucalypts.

Specimens examined: Tasmania, West Ridgley, on *E. globulus*, 16 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W15 (VPRI 21071, Holotype); same location and host, 16 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W17 (VPRI 21072); same location, on *E. nitens,* 16 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W22d (VPRI 21073); Porter Bridge Rd, Deloraine, on *E. pauciflora* Sieber ex Sprengel, 12 Dec. 1995, *Z.Q. Yuan & M. Hall* WC66b (VPRI 21074).

The ascoma habit and size of ascospores, as well as the presence of the delicate ascospore appendages in this fungus are similar to those of *D. eucalypticola* K.M. Old & Z.Q. Yuan described on eucalypt in Australia (Yuan *et al.*, 1995). However, the ascospores of *D. eucalypticola* are elongate-ellipsoid to cylindrical and

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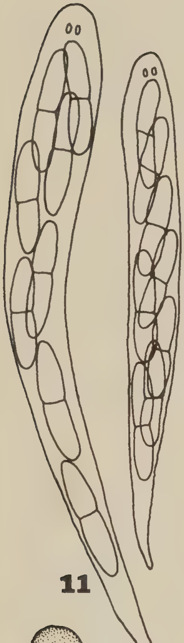
Figs. 11-12: *Bertia antennaroidea* (asci and ascospores) (Holotype); **Fig. 13**: *Karstenula ceanothi* (ascospores); **Fig. 14**: *Fenestella media* (ascospore); **Figs.15-16**: *Diaporthe fusispora* (asci and ascospores) (Holotype); **Figs.17-18**: *Cryptodiaporthe curvata* (asci and ascospores) (Holotype); **Fig. 19**: *Coniochaeta pulveracea* (ascospore); **Figs. 20-21**: *Eutypa spinosa* (asci and ascospores); **Figs.22-23**: *Phomatospora macrospora* (ascospores and ascus) (Holotype) and **Figs.24-26**: *Wuestneia campanulata* (ascospores, ascus apex and ascus) (Holotype) (Bar = 5 µm for Fig.21; =10 µm for Figs.19 & 25; = 20 µm for Figs. 11, 13-18, 20,24 & 26; = 25 µm for Fig.23; = 30 µm for Fig.12 and = 40 µm for Fig.22)



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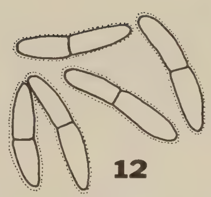

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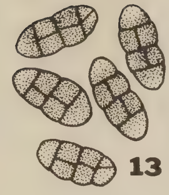

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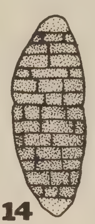

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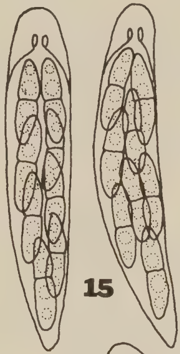

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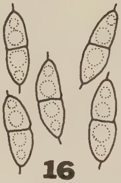

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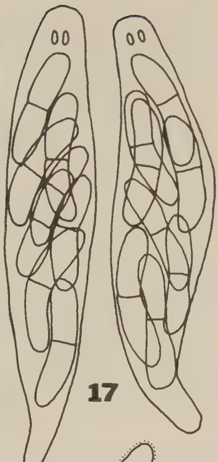

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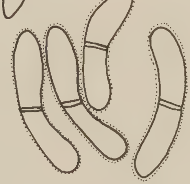

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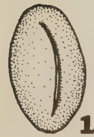

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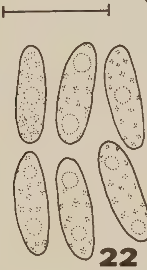

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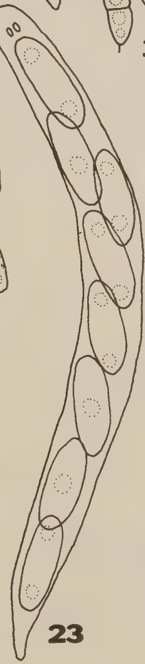

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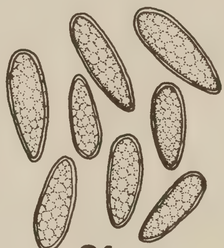

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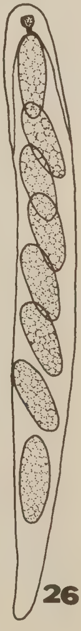

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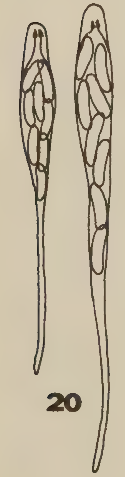

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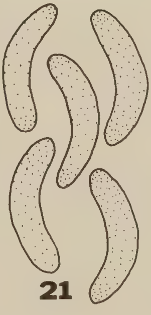

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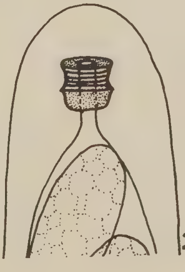

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not constricted at the septum, while those of *D. fusispora* are fusoid in shape and constricted at the septum. *D. medusaea* Nit. (syn. *D. eucalypti* Harkn.), another species previously recorded on eucalypts, has ascospores which are similar to those of the new species in shape. However *D. medusaea* differs in its collectively erumpent ascomata and lack of appendages on the ascospores. In addition, its ascospores are narrower (2.5-3.5 µm wide, *fide* Wehmeyer 1933).

Eutypa spinosa (Pers.: Fr.) Tul. & C. Tul., Sel. Carp. Fung. 2: 59. 1863

Figs. 7, 20 & 21

Stroma long and effused, up to 130 mm long and 10 mm wide, brown to dark brown, punctulate. Perithecia immersed in stromata in a single layer with ostiolar necks separately erumpent (eutypoid); ostioles conical, 3-5 sulcate (mostly 3). Asci unitunicate, cylindrically clavate or spindle-shaped, long-stipitate, with visible amyloid apical rings, 8-spored, 25-35 x 4-6 µm (p. sp.); pedicels 30-80 µm long. Ascospores 1-celled, allantoid or suballantoid, pale brown, 6-8 x 1.8-2.5 µm.

On stems of eucalypt.

Specimen examined: Tasmania, Mawbanna Rd, Mawbanna, on *E. obliqua* L'Hér., 12 Dec. 1995, *Z.Q. Yuan & M. Hall* WC56 (VPRI 21075).

Four species of *Eutypa* have been previously recorded in Australia, of which *E. lata* (Pers.: Fr.) Tul. & C. Tul. and *E. armeniacae* Hansf. M.V. Carter were reported from Tasmania; *E. lata* on the wood and bark of unnamed plants and *E. armeniacae* on *Prunus armeniaca* L. (Cooke, 1892; Sampson & Walker, 1982). However, *E. armeniacae* is considered to be conspecific with *E. lata* by Rappaz (1987). Based on Rappaz (1987), the present fungus on eucalypts easily fits the morphological description for *E. spinosa*. This is the first record of this species from Australia.

Fenestella media Tulasne & C. Tulasne, Sel. Carp. Fung. 2: 207. 1863

Figs. 8, 14 & 36

Ascomata immersed in valsoid groups 1-2 mm wide or in elongated rows 3-4 mm long, 300-500 µm diam. Peridium brown, 30-50 µm thick, of brown, thick-walled pseudoparenchymatous cells 10-12 µm in diam. Asci 100-125 x 18-22.5 µm, clavate, 8-spored. Ascospores irregularly biseriate, 27-40(-52.5) x 10-18 (mean 36.2 x 13.0) µm, yellowish brown to dark brown, end cells pale, ellipsoid-fusoid, ends somewhat acute, 5-13 septa, 3-5 longitudinal septa, constricted at first-formed septum, wall dark, smooth.

On stems of *Eucalyptus* spp.

Specimens examined: Tasmania, Ben Ridge, St. Helens, on *Eucalyptus delegatensis*, 5 Dec. 1995, *Z.Q. Yuan & M. Hall* ET25b (VPRI 20830); Porter Bridge Rd, Deloraine, on *E. pauciflora*, 12 Dec. 1995, *Z.Q. Yuan & M. Hall* WC66c (VPRI 20831).

The fungus fits *F. media* well morphologically, except that the ascospores of *F. media* occasionally bear oblong terminal appendages (Barr, 1990). This species has been found on branches of many hardwood species in the north temperate zone and has not been previously recorded in Australia on eucalypts.

Karstenula ceanothi (Dearness & House) Barr, North American Flora 13: 49. 1990

Figs. 9, 13 & 29

Ascomata gregarious or scattered, immersed in a thin blackened clypeus, spheroid, 300-500 μm wide, 200-300 high, with a short papillate apex. Peridium 25-35 μm wide, brown, of dark thick-walled elongated cells at outer part and hyaline compressed cells at inner part. Asci 100-130 x 10-12 μm, cylindrical, 8-spored. Ascospores 17.5-22.0 x 7.5-10 μm, uniseriate, brown to dark brown, with end cells slightly paler, ellipsoidal to fusoid, with obtuse ends, symmetric, 3-septate, constricted at the first-formed septum, with a longitudinal septum in mid cells, often with one additional longitudinal or oblique septum at one or both end cells; wall smooth.

On dead stems of eucalypts.

Specimens examined: Tasmania, Wayatinah Rd, Tarraleah, on *Eucalyptus* sp., 6 Dec. 1995, *Z.Q. Yuan & M. Hall* ET55 (VPRI 21076); Porter Bridge Rd, Deloraine, on *E. pauciflora*, 12 Dec. 1995, *Z.Q. Yuan & M. Hall* WC66a (VPRI 21077); West Ridgley on *E. nitens,* 16 April 1996, *Z.Q. Yuan*, *C. Mohammed & D. de Little* W22b (VPRI 21078).

Almost all morphological features and measurements of ascomata, asci and ascospores in these collections on eucalypts conform to the description of *K. ceanothi* (Dearness & House) Barr, except that the blackened clypeus was observed only when the ascomata were immersed in groups. *K. ceanothi* is known only from North America (Barr, 1990) and this is the first record in Australia on *Eucalyptus* spp.

Phomatospora macrospora Z.Q. Yuan sp. nov.

Figs. 10, 22, 23, 34 & 35

Etymology: refers to the large ascospores.

Ascomata perithecialia, discreta, alte immersa, sphaeroidea vel plus minus triangula, 300-500 μm lata, 250-400 μm alta. Peridium 9-12 μm crassum, e cellulis pseudoparenchymatis, compressis, brunneolis vel brunneis, leptodermis compositum. Asci 162-213 x 12.5-15.5 μm, cylindracei, leptodermi, cum annulis apicalibus, refractis inamyloideis, octospori. Ascosporae 30-47.5 x 8.8-12.5 μm, irregulariter vel oblique uniseriatae, elliptic-cylindraceae vel fusoid-cylindraceae, aseptatae, hyalinae, 1-2 guttulatae.

Holotypus in ramulis *Eucalypti delegatensis*, Seed orchard, Ridgley, Tasmania 16 April 1996, *Z.Q. Yuan* W20a (VPRI 21079)

Ascomata perithecioid, scattered, deeply immersed, with a minute tip of the perithecial apex protruding through the surface of the host tissue, without stromatic tissue, spheroid to more or less triangular, 300-500 μm wide, 250-400 μm high. Peridium thin, 9-12 µm wide, composed of few layers of thin-walled, compressed pseudoparenchymatous cells, light brown to brown externally. Asci 162-213 x 12.5-15.5 µm, cylindrical, thin-walled, short-stalked, with a small apical nonamyloid ring, 8-spored. Ascospores 30-47.5 x 8.8-12.5 (mean 39.0 x 10.5) µm, irregularly or obliquely uniseriate, elliptic-cylindric to fusoid-cylindric, aseptate, hyaline, with one or two conspicuous oil drops at the centre or ends, granular, thin-walled, smooth.

On stems of eucalypts.

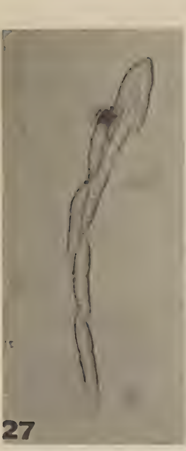
Specimens examined: Tasmania, Seed orchard, Ridgley, on *E. delegatensis*, 16 April 1996, *Z.Q. Yuan* W20a (VPRI 21079, Holotype); Woolnorth, on *E. globulus*, 17 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W11b (VPRI 21080).

The genus *Phomatospora* Sacc. is characterised by having nonstromatic, thin-walled and noncarbonaceous perithecia which are immersed in host tissue and possess an apical ostiole with periphyses. Asci are unitunicate and formed in a basal layer. There is a faint refractive (nonamyloid) ring in the apex of an ascus.

Most species of *Phomatospora* are found on herbaceous stems and grass culms. (von Arx & Müller, 1954; Barr, 1970; Wehmeyer, 1975; Rappaz, 1992) and only *P. dinemasporium* J. Webster, a common species found on many grass culms (Webster, 1955), has been recorded on the wood of *Eucalyptus viminalis* in Argentina (Romero, 1983; Sankaran *et al.*, 1995).

The new species differs from all the known species in the genus by its large ascospores, hence the specific epithet. Species of *Phomatospora* have ascospores generally less than 25 µm long, while the present fungus on eucalypts has ascospores measuring 30-47.5 x 8.8-12.5 µm. Only one species, *P. punctulata* Hino & Katumoto has comparably sized ascospores which measure 23-35 x 6.5-8 (mean 28.9 x 7.2) µm but they are contained in shorter asci (*fide* Kobayashi, 1970). The woody habit of the perithecia and the relatively large, one-celled, cylindrical and nonpigmented ascospores of the new species may suggest affinities with *Cryptospora* Tulasne. However, species of *Cryptospora* have perithecia embedded in stromatic tissue in circular groups with long ostiolar necks collectively erumpent, shorter asci with deliquescent bases, and the ascospores are subcylindrical, curved and mainly longer than 50 µm (Müller & von Arx, 1973; Dennis, 1981).

Figs.27-28: *Bertia antennaroidea* (asci and ascospores) (Holotype); **Fig.29**: *Karstenula ceanothi* (ascospores); **Fig.30**: *Diaporthe fusispora* (asci and ascospores) (Holotype); **Fig.31**: *Coniochaeta pulveracea* (ascospore); **Figs.32-33**: *Cryptodiaporthe curvata* (asci and ascospores) (Holotype); **Figs.34-35**: *Phomatospora macrospora* (ascospores and ascus) (Holotype); **Fig.36**: *Fenestella media* (ascospore); **Figs.37-40**: *Wuestneia campanulata* (ascus apex, ascus and ascospores) (Holotype) (Bar = 20 µm for Figs.29-31 & 36-18; = 30 µm for Figs. 17,18,33 & 34; = 35 µm for Figs.39 & 40; = 40 µm for Fig.32)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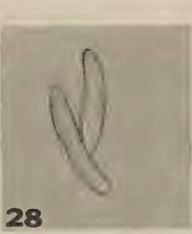
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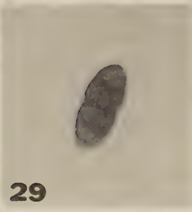
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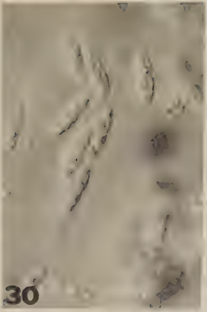
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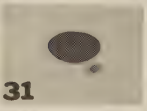
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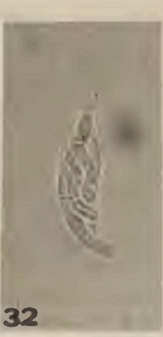
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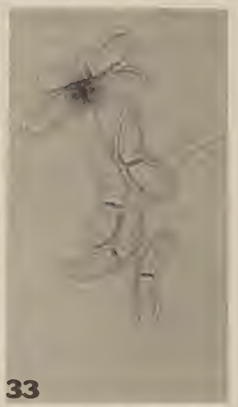
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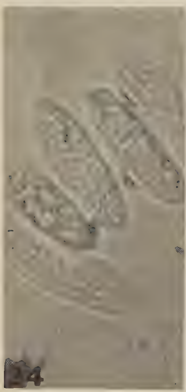
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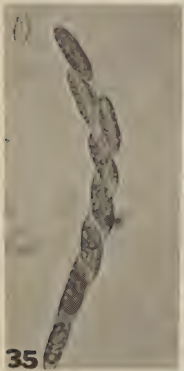
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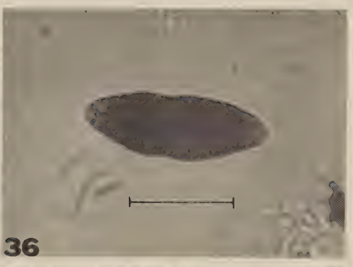
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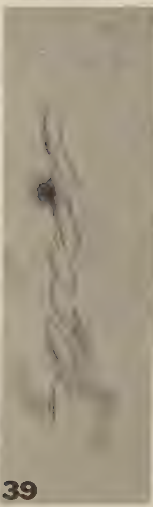
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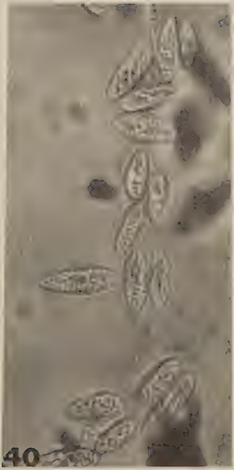
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Wuestneia campanulata Z.Q. Yuan sp. nov.

Figs. 24-26 & 37-40

Etymology: refers to the shape of the ascal apical apparatus.

Ascomata perithecialia, singula vel 2-5 aggregata, immersa, rostro peritheciali erumpenti, 15 mm diam, disco ectostromatico furfuraceo brunneo vel fulvo. Perithecia sphaerica vel subsphaerica, 350-550 μm diam, atrobrunnea, rostro perithecii cylindraceo vel subcylindraceo, 350 μm longo, basi 80 μm crasso. Peridium 15-20 μm crassum, pseudoparenchymaticum, ex cellulis parietibus atrobrunneis, 4-8 μm diam compositum. Asci 100-150 x 12.5-17.5 μm, unitunicati, cylindracei vel subcylindracei, apice rotundati, cum apparatibus 3.5-5.0 x 4-5 μm, apicalibus, campanulatis, distinguentibus, inamyloideis, octospori (raro 4-spori). Ascosporae 17.5-27.5 x 6.5-10 μm, oblique vel irregulariter uniseriatae, hyalinae, elliptic-fusoideae vel obovoideae, ad apicem acutulae, aseptatae, parietibus crassis, laeves, granulatae.

Holotypus in ramulis *Eucalypti pauciflora*, Pine Tree Rivulet, Tasmania 6 Dec. 1995, *Z.Q. Yuan & M. Hall* ET44a (VPRI 21081)

Ascomata perithecial, single or in groups of 2-5, immersed, with emergent perithecial necks, appearing on the host surface as prominent oval pustules, up to 1.5 mm diam, ectostromatic disc furfuraceous brown to yellow-brown. Perithecia dark brown, spherical or subspherical, 350-550 μm diam. Perithecial neck cylindrical to subcylindrical, up to 80 μm wide at base and 350 μm long. Peridium 15-20 μm wide, composed of several layers of dark brown pseudoparenchymatous cells, 4-8 μm diam. Asci 100-150 x 12.5-17.5 (mean = 132 x 15) μm, unitunicate, cylindrical to sub-cylindrical, rounded at apex, with a distinct, campanulate, apical apparatus; 3.5-5.0 μm wide, 4-5 μm high, not blueing in iodine, 8-spored (rarely 4-spored). Ascospores 17.5-27.5 x 6.5-10 (mean = 22 x 8) μm, obliquely or irregularly uniseriate, hyaline, elliptic-fusoid to obovoid with one end somewhat acute, aseptate, thick-walled, smooth, granular.

On stems of eucalypts.

Specimens examined: Tasmania, Pine Tree Rivulet on *Eucalyptus pauciflora*, 6 Dec. 1995, *Z.Q. Yuan & M. Hall* ET44a (VPRI 21081, holotype); Black Jack's Hill, Little Swanport, on *E. amygdalina*, 5 Dec. 1995, *Z.Q. Yuan & M. Hall* ET8b (VPRI 21082); Pine Tree Rivulet, on *Eucalyptus* sp, 6 Dec. 1995, *Z.Q. Yuan & M. Hall* ET43a (VPRI 21083); Fingerpost, Waratah, on *E. nitens*, 11 Dec. 1995, *Z.Q. Yuan & M. Hall* WC27 (VPRI 21084); Welcome River, Montagu, on *E. ovata*, 11 Dec. 1995, *Z.Q. Yuan & M. Hall* WC37b (VPRI 21085); Saggers Hill on *E. nitens* (?),13 Dec. 1995, *Z.Q. Yuan & M. Hall* WC64 (VPRI 21086); Woolnorth, on *E. globulus*, 17 April 1996, *Z.Q. Yuan, C. Mohammed & D. de Little* W10 (VPRI 21087).

Two species of the genus *Wuestneia*, *W. eucalyptorum* Crous, Wingfield & Nag Raj and *W. epispora* Z. Q. Yuan have been previously recorded on eucalypts (Crous *et al*., 1993; Yuan & Mohammed, 1996). Compared with *W. epispora*, also found in Tasmania, *W. campanulata* is morphologically different from the former.

The asci of *W. epispora* are clavate, much larger (100-188 x 13-33 µm), and there is no apical apparatus observed at apex of those asci, while the asci of *W. campanulata* are smaller, cylindrical to subcylindrical, with ascospores monostichously arranged, and characteristically with a distinct, campanulate, 'annellascé' apical apparatus (*sensu* Chadefaud, 1942) (Figs. 25, 37-39). The ascospores of *W. campanulata* are also smaller than those of *W. epispora* and elliptic-fusoid to obovoid, without any gelatinous sheath surrounding them. In addition, the perithecium diameter of *W. campanulata*, a main criterion used by Reid & Booth (1989) to separate species of *Wuestneia*, is larger (up to 550 µm and mostly 500 µm) than that of *W. epispora*. Apart from the above morphological differences, *W. epispora* appears commonly associated with lower crown death in plantation eucalypts, whilst *W. campanulata* was more often found in native forests. *W. eucalyptorum* differs from *W. campanulata* in its absence of apical ascus apparatus and shape of ellipsoidal ascospores, as well as the phyllodiicolous habit (Crous *et al.*, 1993).

In the key to species of *Wuestneia* provided by Reid & Booth (1989) *W. campanulata* keys out to *W. beltsvillensis* (Petrak) J. Reid & C. Booth. However, the latter can be easily separated from *W. campanulata* by (*i*) smaller perithecia (200-425 µm diam.) that are always in groups (4-15) with thicker peridium (up to 40 µm); (*ii*) an ascal apical apparatus which is only visible when mounted in water (while that of *W. campanulata* is always visible in both water and other mounting media, eg. in glycerol); (*iii*) shorter but wider (70-140 x 12-22.5 µm) asci and (*iv*) slightly smaller ascospores which are more fusiform in shape with a thin mucilaginous sheath when mounted in water. In addition, *W. beltsvillensis* seems to be restricted to *Liquidambar* L., a genus of the Hamamelidaceae (Reid & Booth, 1989).

The ascal apical apparatus observed in many species of *Wuestneia* has been described as two refractive bodies (Barr, 1978; Ananthapadmanaban, 1988; Reid & Booth, 1989), but has not been previously observed in detail. Based on Parguey-Leduc *et al.* (1994), the apical apparatus in the asci of *W. campanulata* matches Chadefaud's "annellascé" type being composed of two parts: an upper ring and a lower ring as illustrated in Figs. 25, 37 and 38. The upper ring is composed of several rings and is superimposed on a lower single bowl-shaped ring.

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REFERENCES

Ananthapadmanaban, D. (1988). On the genus *Wuestneia*. *Transactions of British mycological Society* **91**: 517-521.

Arx, J.A. von and Müller, E. (1954). Die Gattungen der amerosporen Pyrenomyceten. *Berträge zur Kryptogamenflora der Schweiz* **11**: 1-434.

Barr, E.M. (1970). Some amerosporous ascomycetes on Ericaceae and Empetraceae. *Mycologia* **62**: 377-394.

Barr, M.E. (1978). The Diaporthales in North America, with emphasis on *Gnomonia* and its segregates. *Mycologia Memoir* **7**: 1-232.

Barr, M.E. (1990). Melanommatales (Loculoascomycetes). *North American Flora* II. **13**: 1-129.

Bathgate, J.A., Barr, M.E. and Shearer, B.L. (1996). *Cryptodiaporthe melanocraspeda* sp. nov. the cause of *Banksia coccinea* canker in south-western Australia. *Mycological Research* **100**: 159-164.

Cannon, P.F. (1995). Studies on fungi with isthmoid ascospores: the genus *Vialaea*, with the description of the new family Vialaeaceae. *Mycological Research* **99**: 367-373.

Chadefaud, M. (1942). Étude d'asques. Structure et anatomie comparée de l'appareil apical des asques chez divers Disco-et Pyrénomycètes, *Revue de Mycologie* **7**: 57-88.

Cooke, M.C. (1892). 'Handbook of Australian Fungi'. Williams & Norgate, London.

Corlett, M. and Krug, J.C. (1984). *Bertia moriformis* and its varieties. *Canadian Journal of Botany* **62**: 2561-2569.

Crous, P.W., Wingfield, M.J. and Nag Raj, T.R. (1993). *Harknessia* species occurring in South Africa. *Mycologia* **85**: 108-118.

Dennis, R.W.G. (1981). 'British Ascomycetes.'(second impr., with suppl.) J. Cramer, Vaduz. 585 + 40pp.

Hawksworth, D.L., Kirk, P.M., Sutton, B.C. and Pegler, D.N. (1995). *Ainsworth and Bisby's Dictionary of the Fungi* (8th ed.). CAB International, Egham, Surrey. England.

Hawksworth, D.L. and Yip, H.Y. (1981). *Coniochaeta angustispora* sp. nov. from roots in Australia, with a key to the species known in culture. *Australian Journal of Botany* **29**: 377-384.

Hsieh, W.H, Chen, C.Y. and Sivanesan, A. (1995). Taiwan fungi: new species and new records of ascomycetes. *Mycological Research* **99**: 917-931.

Hyde, K.D. (1995). Tropical Australian freshwater fungi 8. *Bertia convolutispora* sp. nov. *Nova Hedwigia* **61**: 141-146.

Kobayashi, T. (1970). Taxonomic studies of Japanese Diaporthaceae with special reference to their life histories. *Bull. Government Forest Research Experimental Sta*. **226**: 1-242.

Krug, J.C. and Corlett, M. (1988). A new species of *Bertia* from China. *Canadian Journal of Botany* **66**: 1256-1258.

Mahoney, D.P. and LaFavre, J.S. (1981). *Coniochaeta extramundana*, with a synopsis of other *Coniochaeta* species. *Mycologia* **73**: 931-952.

Mathiassen, G. (1993). Corticolous and lignicolous pyrenomycetes s. lat. (Ascomycetes) on *Salix* along a mid-Scandinavian transect. *Sommerfeltia* **20**: 1-180.

Müller, E. and Arx, J.A. von (1973). Pyrenomycetes: Meliolales, Coronophorales, Sphaeriales. In 'The fungi.' (Vol. 4) (Eds. H.C. Ainsworth, F.K. Sparrow & A.S. Sussman) pp. 87-132. Academic Press, New York.

Munk, A. (1957). Danish pyrenomycetes. *Dansk Botanisk Arkiv* **17**: 1-491.

Parguey-Leduc, A., Janex-Favre, M.-C., Letrouit-Galinou, M.-A. and Bellemère, A. (1994). M. Chadefaud and ascomycete systematics. In 'Ascomycete Systematics: Problems and Perspectives in the Nineties'. (Ed. D.L. Hawksworth) pp. 37-41. Plenum Press, New York.

Rappaz, F. (1987). Taxonomie et nomenclature des Diatrypacées à asques octospores (1). *Mycologia Helvetica* **2**: 285-648.

Rappaz, F. (1992). *Phomatospora berkeleyi*, *P. arenaria* and their *Sporothrix* anamorphs. *Mycotaxon* **45**: 323-330.

Reid, J., & Booth, C. (1989). On *Cryptosporella* and *Weustneia*. *Canadian Journal of Botany* **67**: 879-908

Romero, A.I. (1983). Contribición al estudio de los hongos xilofilos de la Argentina. I. Deuteromycotina en *Eucalyptus viminalis* (Myrtaceae). *Boletin de la Sociedad Argentina de Botanica* **22** : 57-79.

Sampson, P.J. and Walker, J. (1982). 'An annotated list of plant diseases in Tasmania'. Department of Agriculture Tasmania, Hobart. 121pp.

Sankaran, K.V., Sutton, B.C. and Minter, D.W. (1995). A checklist of fungi recorded on *Eucalyptus*. *Mycological Papers* **170**: 1-376.

Subramanian, C.V. and Sekar, G. (1990). Coronophorates from India - A monograph. *Kavaka* **18**: 19-90.

Webster, J. (1955). Graminicolous Pyrenomycetes. V. Conidial states of *Leptosphaeria michoti, L. microscopica, Pleospora vagans* and the perfect state of *Dinemasporium graminum*. *Transactions of British mycological Society* **38**: 347-365.

Wehmeyer, L.E. (1933). The genus *Diaporthe* Nitschke and its segregates. *Univ. Michigan Stud. Sci. Ser.* **9**: 1-349.

Wehmeyer, L.E. (1975). The pyrenomycetous fungi. *Mycologia Memoir* **6**: 1-250.

Yuan, Z.Q. and Mohammed, C. (1996). *Wuestneia epispora* sp. nov. on stems of eucalypts from Australia. *Mycological Research* (in press)

Yuan, Z.Q., Old, K.M. and Dudzinski, M.J. (1995). A new species of *Diaporthe* isolated from stem wounds of eucalypts in Australia. *Mycotaxon* **55**: 507-514.

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HYGROPHORACEAE OF WESTERN AUSTRALIA

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ABSTRACT

Four species of Hygrophoraceae are described from south-west Western Australia. *Hygrocybe conica* (Schaeff.: Fr.) Kummer var. *conica* f. *conica*, and *Hygrocybe miniata* (Fr.: Fr.) Kummer var. *miniata* are widely distributed throughout the world, whereas *Hygrocybe polychroma* and *Hygrocybe viscidibrunnea* are previously undescribed and may be endemic to Australia.

INTRODUCTION

A large diversity of Hygrophoraceae occurs in eastern Australia (Mills & Monks, 1993; Young, 1996) and in New Zealand (Horak, 1990). However only four species of Hygrophoraceae have been previously reported in Western Australia (Hilton, 1982; 1988). These are *Hygrocybe coccinea* (Fr.) Kummer which is probably *Hygrocybe kandora* Grgurin. & A.M. Young nom. prov. (Young, 1996), *Hygrocybe conica* (Fr.) Kummer, *Hygrocybe cantharellus* (Schw.: Fr.) Murrill and *Hygrophorus laetus* (Fr.) Fr. The Hygrophoraceae typically produce small to medium-sized brightly coloured basidiomes with thick, waxy lamellae. The number of accepted genera varies according to various authors: e.g. *Hygrophorus* Fr. is used in a very narrow sense, or to encompass *Bertrandia* Heim, *Camarophyllus* (Fr.) Kummer, *Gliophorus* Herink, *Hygrocybe* (Fr.) Kummer, *Hygrotrama* Singer, *Neohygrocybe* Herink and others as sections or subgenera. In this paper we place all four of the species in *Hygrocybe*, and follow the precedent set by the structure of Arnolds (1990) which reduced *Gliophorus* to synonomy with *Hygrocybe*. In this study we provide descriptions of recently collected *H. conica*, *H. miniata*, and two new species - *Hygrocybe polychroma* and *Hygrocybe viscidibrunnea*. All are from the high rainfall zone of south-west Western Australia. Colour illustrations of the fungi described in this paper are published in Bougher and Syme (1997).

METHODS

Basidiomes collected from the field were described, and then air-dried for later examination. Dried material was hydrated and examined in 3% KOH and Melzer's reagent. Microscopic characters were drawn with an Olympus drawing tube system. All spore measurements include the hilar appendix. Colour codes quoted are from Kornerup & Wanscher (1978). Specimens designated as E numbers are held at the CSIRO Division of Forestry, Perth, Western Australia.

DESCRIPTION OF THE SPECIES

Hygrocybe conica (Schaeff.: Fr.) Kummer, *Führ. Pilzk. 111 (1871).* var. *conica* f. *conica*
Basionym: *Agaricus conicus* Schaeff. , *Fungi Bavariae 4: 2 (1774)*; non. *A. conicus* Scop., (1772).
Agaricus conicus Schaeff.: Fr., *Systema mycol. 1: 103 (1821).*
Hygrophorus conicus (Schaeff.: Fr.) Fr., *Epicr. ; 331 (1838).*
Godfrinia conica (Schaeff.: Fr.) Maire, *Bull. Soc. mycol. Fr. 18 (suppl.): p. 117 (1902).*
Agaricus tristis Pers., *Observ. mycol. 2: 49 (1796).*
Hygrophorus tristis (Pers.) Bres., *Iconogr. mycol. 7: 349 (1928).*
Hygrocybe tristis (Pers.) F. Møller, *Fungi Faeroes 1: 140 (1945).*
Hygrocybe pseudoconica J. Lange, *Dansk. Bot. Ark. 4: 24 (1923).*
Hygrocybe conica f. *pseudoconica* (J. Lange) Arnolds, *Persoonia 12: 476 (1985).*
Hygrocybe riparia Kriesil, *Westf. Pilzbr. 2: 111 (1960).*
Misapplied name: *Hygrophorus nigrescens* sensu auct. non. Quél., *Hygrocybe nigrescens* sensu auct.

Figs. 1, 2.

Pileus 5-25 mm broad, sharply conic at first, then broadening but always remaining conic or conico-campanulate, margin slightly incurved at first, then plane or decurved, sometimes translucent-striate and coarsely crenate or lobed when mature. Orange (8B8-9B8), red then yellow tinged, becoming yellowish at the margin and black at the centre with age and upon handling. Surface moist/greasy, on drying revealing radially arranged, long, innate and appressed fibrils which blacken when bruised. **Lamellae** adnexed to emarginate, up to 4 mm deep, close spacing, lamellulae present (e.g. L:16, l:15), also some bifurcations. With a pinkish flush near to the pileus - otherwise pale yellow (4A4) not changing greatly with age. Edge concolorous with face and smooth, entire and undulating with age. Lamellae may sometimes bruise black. **Stipe** 40-60 x 3-5 mm, tall, cylindrical or very slightly tapering upwards, often twisted. Hollow, dry, longitudinally fibrillose and striate, fibrils blackening upon handling. Apex with or without red flush (6A7), central region pale yellow (2A4), white at the base. **Flesh** pale yellow, darkening when cut, thin in the pileus. **Basal mycelium** not conspicuous. **Odour** not distinctive. **Taste** none. **Spore deposit** white.

Spores hyaline in water and in KOH, with one oil bubble or granular contents, not amyloid, (8) 8.5-11 x 5.5-7 µm, mean 10.1 x 6.2 µm (n = 55). Ellipsoid to obovoid (broadest at apex) in face view and in profile, smooth, thin-walled. **Basidia** 30-50 x 7-11 µm, clavate to ventricose, hyaline, thin-walled, sterigmata very long (up to 15 µm), 1- or 2-spored, no clamp connection at base. **Cheilocystidia**, **Pleurocystidia**, and **Caulocystidia** none seen. **Hymenophoral trama** parallel, with long tubuliform hyphae 5-15 µm broad, smooth, thin-walled, hyaline, aseptate, tapered at the ends. Some oleiferous hyphae with golden contents present in the central strand. **Subhymenium** not differentiated, no clamp connections. **Pileipellis** a cutis of thin-walled hyphae (8-25 µm broad), hyaline or some of the narrower hyphae with blotchy or oily brown contents and uneven walls. Outermost hyphae sometimes compressed and coagulated together. End-cells not differentiated. **Clamp connections** absent in all tissues.

Habitat and distribution in Australia On ground in soil, grass, lawns or litter, solitary or in small groups. Australian forms of this species are known from Western Australia, South Australia, New South Wales and Queensland.

Collection detailed/illustrated Western Australia, William Bay National Park, in sand along track, near *Agonis flexuosa* & *Hibbertia cuneiformis*, 31 May 1993, coll. *A. & K. Syme KS 661/93* (PERTH 04259602). **Other collections examined** Western Australia, Bibra Lakes, Perth, in soil, 23 June, 1971, coll. *Young 93* (PERTH 759295 = UWA 1435). Western Australia, Adams Road Reserve, Dalkeith , Perth, in soil, 6 and 9 June 1973, coll. *F. Morris & R. Hilton s.n.* (PERTH 763624 = UWA1663, and PERTH 764078 = UWA1683).

General notes

Hygrocybe conica is easily recognised by its conical, brightly coloured yellow-orange to red-orange caps which eventually blacken with age and when handled. The cap of W.A. specimens is moist/greasy, then finely fibrillose when drying out. The lamellae are pale yellow and also blacken. The W.A. specimens relate to *H. conica* variety *conica* form *conica*, characterised by 2-spored basidia without basal clamp connections. The predominantly 4-spored form *pseudoconica* which has larger bright red caps also occurs in Australia. *Hygrocybe nigrescens* (Quél.) Kühn. is very similar and now considered inseparable from *H. conica* by some authors (e.g. Arnolds, 1990). *H. conica* var. *tierneyi* A.M. Young *nom. prov.* also occurs in Australia. It differs from var. *conica* by having a viscid cap and only the stem blackens (Young, 1996). In Australia, *H. conica* may be confused with the similar appearing *Hygrocybe astatogala* (Heim ex Heim) Heinemann (synonymous with *Bertrandia astatogala* Heim ex Heim), which can be distinguished by its sometimes distinctly greenish young colours, and by often exuding a clear fluid when cut (Horak, 1990). Microscopically it differs by having cystidia on the edge of the lamellae, and broad (almost globose) spores often with dark contents. *H. astatogala* has not been reported for Western Australia but occurs widely in eastern Australia.

Hygrocybe miniata (Fr.: Fr.) Kummer, *Führ. Pilzk. 112 (1871).* var. *miniata*
Basionym: *Agaricus miniatus* Fr.: Fr., *Syst. Mycol. 1: 105 (1821).*
Hygrophorus miniatus (Fr.: Fr.) Fr., *Epicr.: 33 (1838).*
Hygrophorus strangulatus P.D. Orton, *Trans. Br. mycol. Soc. 43: 266 (1960).*
Hygrocybe strangulata (P.D. Orton) Svrcek, *Ceská Mykol. 16: 167 (1962).*

Figs. 3-5.

Pileus up to 45 mm broad, convex with incurved margin, expanding to flat with an unevenly crenulate or wavy margin, not translucent-striate. Entirely bright red (11B8-11C8 but more saturated colour), becoming paler as drying out with age. Surface moist but not sticky under damp conditions, drying innately velutinous (see under lens), otherwise smooth. **Lamellae** adnate, up to 7 mm deep, waxy, close or subdistant spacing, with two tiers of lamellulae (e.g. L = 10; l = 33), pale yellow near the pileus (6A4), with pinkish tinge near gill edge (10B6), edge smooth and entire. **Stipe** up to 60 x 7 mm, cylindrical or widest at apex, hollow at least at the apex, sometimes with longitudinal grooves or lines, same colour as the pileus except pale yellowish at the base, dry, smooth. **Flesh** pinkish in the pileus, yellowish in the stipe, not bruising. **Basal mycelium** not conspicuous. **Odour** not distinctive. **Taste** none. **Spore deposit** white.
Spores hyaline in water and in KOH, often with one large oil bubble, not amyloid, 8.5-11.5 (12) x 5-6.5 (7) µm, mean 9.9 x 5.8 µm (n = 55). Ellipsoid or some subcylindric in face view, ellipsoid in profile, suprahilar region not constricted, smooth, thin-walled. **Basidia** 45-65 x 6-10 µm, slender cylindro-clavate, hyaline, thin-walled, sterigmata up to 10 µm long, 4-spored, clamp connection at base. **Cheilocystidia** and **Pleurocystidia** none seen. **Caulocystidia** similar to the end-cells of

the pileipellis (see below) - cylindrical, clavate, fusoid, hyaline, turning outwards from the non-gelatinised Stipitipellis (cutis), clamp connections present. **Hymenophoral trama** slightly interwoven , hyaline hyphae (2-12 µm broad), with clamp connections. **Subhymenium** not differentiated. **Pileipellis** a trichoderm comprised of thin- and smooth-walled hyphae, with constricted septa and clamp connections. Not gelatinised. End-cells 40-125 x 8-15 µm, overlapping and erect, cylindrical, slender-clavate, fusoid. Pigment contained in pileus trama and pellis elements golden yellow in KOH and in water, rapidly dissolving. **Clamp connections** present in all tissues.

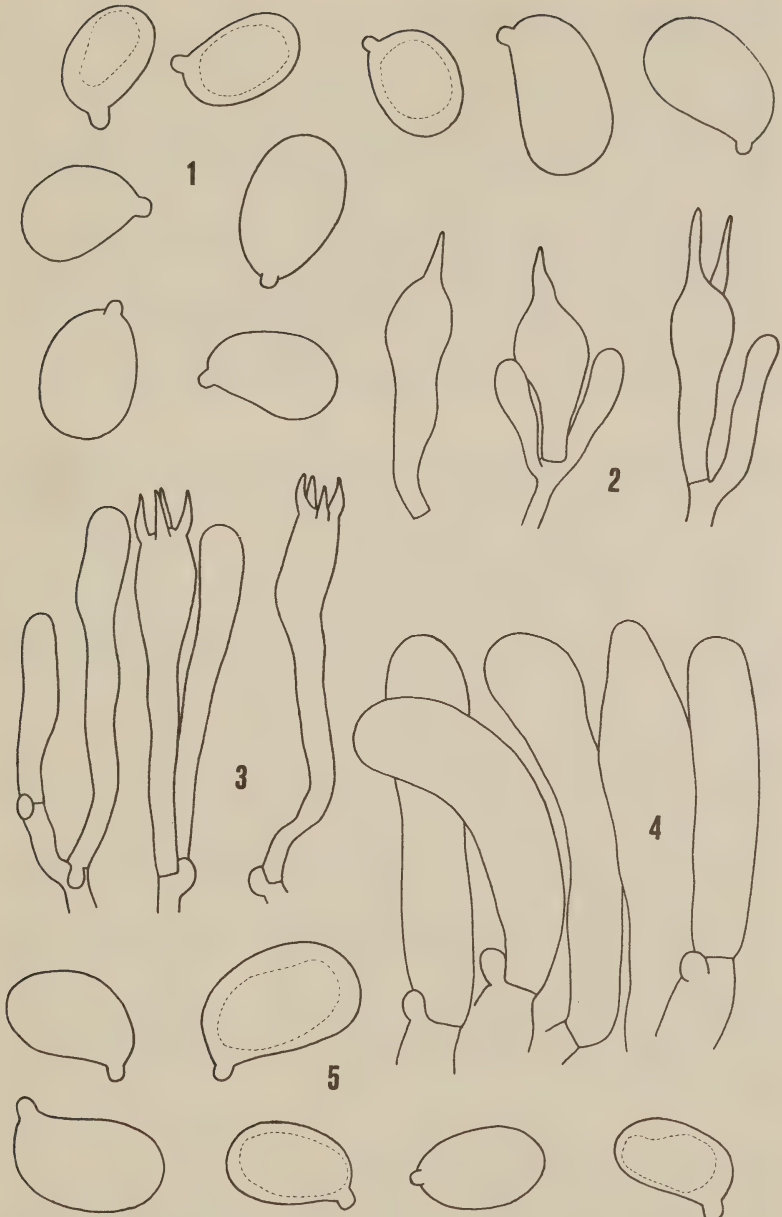
Habitat and distribution in Australia On ground in litter, grass, among moss, less often on rotting wood, in small groups or large numbers. Throughout south-west Australia, and common in eastern Australia.

Collection detailed/illustrated Western Australia, William Bay National Park, south east of Lake Williams, in litter under *Agonis flexuosa* & *Oxylobium* sp., 2 August 1993, coll. *K. Syme & B. Hammersley KS 688/93* (PERTH 04259653). **Other collections examined** Western Australia, Valley of the Giants, Walpole-Nornalup area, in litter, 7 Sept. 1981, coll. *O. Miller OKM 19498* (PERTH 914045 = UWA 2795 lodged as *H. cantharellus*, only transparency - specimens not available).

General notes

Hygrocybe miniata has small fruit bodies which are bright red then fading to orange-yellow and becoming minutely scaly especially near the centre of the cap as drying out. It is distinguished from other vivid red members of the genus by having convex, non-viscid pilei which may develop minute scales when mature, and a pileipellis composed of more or less perpendicular hyphae (trichoderm). The name *H. miniata* represents a group of very similar fungi variously considered as varieties and/or species, but most of them cannot easily be distinguished (Arnolds, 1990). The species or variety *mollis*, which has not been recorded in Australia, is one of the easier taxa to distinguish as it has orange-yellow pilei. Western and eastern Australian collections of *H. miniata* have a spore range that is slightly larger than that of European collections - (5.5) 6-9 (11) x 4-6 (6.5) µm (Arnolds, 1990). Despite the larger spores, Australian collections appear to satisfy all other characters of the European species and are therefore retained as *H. miniata.*

Figs. 1, 2. *Hygrocybe conica* KS661/93: **1.** basidiospores (2000 X). **2.** basidia (1000 X).
Figs. 3 - 5. *Hygrocybe miniata* KS 688/93: **3.** basidia (1000 X). **4.** terminal elements in the pileipellis (1000 X). **5.** basidiospores (2000 X).



Hygrocybe polychroma Bougher & A.M. Young, sp. nov.

Figs. 6-8, 12.

Pileus 14-58 mm latus, aureus vel coccineus, glaber, viscidus, convexus habens margines incurvato denique applanatus habens margines recurvo, undulato, translucido-striato. Lamellae adnexae, confertae, ceraceae, aureae vel coccinea, margines concolori. Stipes 25-85 x 3-8 mm, cylindrici vel fusiformes vel complanati, glabrati, fistulosi, super coccineus, infra aureo habens basem albidum. Sporae 8-10.5 x 4-5 (5.5) µm, ellipsoideae, hyalinae, inamyloideae. Basidia 32-40 x 7-10 µm, (2) 4- spora, fibulata. Cheilocystidia nulla. Pleurocystidia nulla. Caulocystidia 35-55 x 3-5 µm, cilindrica, contorta, flexuosa, hyalina, tenuitunicata. Trama hymenophoralis regularis, fibulae nullae, cum hyphis refractis. Epicutis pilei ixotrichodermem formans. Gregaria in humo inter arbores. Holotypus Australia occidentalis, D'Entrecasteaux National Park, sub *Agonis flexuosa* & *Allocasuarina fraseriana*, 6.6.1992, PERTH 04259645, (isotypus CSIRO E4756).

Etymology: *polychroma* refers to the large variation in the colour of the basidiomes.

Pileus 14-58 mm broad, convex at first with incurved, smooth, entire margin, expanding to plane or slightly uplifted with undulating, translucent-striate margin which may split when over-mature. Colour varies greatly - e.g. entirely intense bright red (11D8 but redder), bright yellow-orange (5A7) when young, later grading to paler or less intense colours towards the pileus margin. Sometimes entirely white. Surface viscid, drying greasy, smooth. **Lamellae** adnexed, up to 7 mm deep, waxy, closely spaced, lamellulae abundant, variable colour - e.g. red (11C8) or yellow (3A4), edge paler or same colour as face, and smooth or eroded with age. **Stipe** 25-85 x 3-8 mm, cylindrical, fusoid, or often flattened or bilobed, variable colour - e.g. entirely or only upper stipe red (11D8), yellow (3A5) in lower stipe, often grading to a whitish base, hollow, fragile and longitudinally fibrous, surface waxy, smooth. **Flesh** red in pileus, yellow in stipe, not bruising. **Basal mycelium** not conspicuous. **Odour** not distinctive. **Taste** none. **Spore deposit** white.

Spores hyaline in water and in KOH, often with one large oil bubble, not amyloid, 8-10.5 x 4-5 (5.5) µm, mean 9.1 x 4.5 µm (n = 50). Ellipsoid to cylindric in face view and in profile, smooth, thin-walled. Suprahilar region not or barely indented. **Basidia** 32-40 x 7-10 µm, cylindro-clavate, hyaline, thin-walled, sterigmata up to 6 µm long, 4-spored (rarely 2), clamp connection at base. **Cheilocystidia** and **Pleurocystidia** none seen. **Caulocystidia** 35-55 x 3-5 µm, cylindrical, contorted, flexuous, hyaline or refractive, smooth, thin-walled, occurring singly or in scattered, small, tangled clusters arising from the non-gelatinised Stipitipellis with clamp connections. **Hymenophoral trama** parallel, with hyaline, thin-walled, colllapsing, tubuliform hyphae 5-35 µm broad x 2000-3000 µm long, aseptate. Some oleiferous hyphae present. **Subhymenium** not differentiated. **Pileipellis** a narrow ixotrichoderm comprised of loosely arranged, hyaline, smooth-walled hyphae (2-8 µm broad) with clamp connections, embedded in a hyaline gelatinous matrix. End-cells not differentiated or some very slightly tapering. Merging below with broader hyphae (up to 20 µm broad) of the pileus trama, thin and thick-walled (1 µm broad or less). **Clamp connections** present in the hymenium and pellis, but absent in the hymenophoral trama.

Habitat, and distribution On ground in sandy, peaty, grassy or mossy soil, in small groups or large numbers. In high rainfall zone of south-west W.A.

Collection detailed/illustrated Western Australia, D'Entrecasteaux National Park, Mandalay Beach Road, in sand and moss near *Agonis flexuosa* & *Allocasuarina fraseriana*, 6 June 1992, coll. *N. Bougher & K. Syme s.n.* (holotype PERTH 04259645, isotype at CSIRO E4756). **Other collections examined** Western Australia, Bibra Lakes, Perth, on soil, 30 June 1971, coll. *A. M. Young Young 151* (PERTH 757721 = UWA 1467). Western Australia, Pitcher Flat, near western boundary of Two People's Bay, 4 June 1975, *coll. G. Smith s.n.* (PERTH 00772577). Western Australia, Arboretum Rd., near Perup, in litter under *Melaleuca* shrubs, 22 June 1985, *coll. N. Bougher NB 115* (duplicate at ZT 2723). Same location as holotype, 15 July, 1994, coll. *N. Bougher, K. Syme, T. Lebel, & M. Brundrett s.n.* (CSIRO E5189).

General notes

Hygrocybe polychroma is characterised by its extremely variable and bright colours - white, yellow, orange and red basidiomes are often mixed within the same group. Unlike *H. conica*, its pilei are not conical and do not turn black. Basidiomes of *H. polychroma* resemble those of *H. marchii* (Bres.) Singer but the two species differ microscopically, e.g. long versus short hymenial trama elements respectively. *H. punicea* (Fr.) Kummer (with viscid pileus) and *H. coccinea* (without viscid pileus) also have some resemblance to *H. polychroma*, but have more consistently cherry or blood red pilei and shorter elements in the lamellae trama.

Hygrocybe viscidibrunnea Bougher & A.M. Young, sp. nov.

Figs. 9-11, 13.

Pileus usque ad 40 mm, plano-convexus habens margines incurvato dein habens depressum, denique habens margines recurvo undulato, glaber, viscido ad glutinosum, aurantio-brunneo. Lamellae decurrentes, ceraceae, confertae ad sub-distantes, pallido-sulphureo-griseae, margines glaber, integras. Stipes usque 62 x 5 mm, cylindici vel supra angusto, viscidi vel glutinoso fistulosi, glabri, sura griseo-virides vel lutei, infra lutei vel griseo-aurantiaci. Sporae 7-9 x(9.5) x 4.5-5.5 (6) µm, ellipsoideae vel lato-ellipsoideae, hyalinae, inamyloideae. Basidia 30-45 x 4-7 µm, 4-spora, fibulata. Cheilocystidia 20-50 x 2-4 µm, hyalina, tenuitunicata, hyphae simulans. Pleurocystidia nulla. Caulocystidia nulla. Trama hymenophoralis regularis, fibulata raro. Epicutis pilei ixotrichodermem formans. Stipiticutis ixotrichodermem formans. Gregaria in humo turfoso in sylva (*Agonis* sp.). Holotypus Australia occidentalis, Denmark, sub *Agonis juniperina* et *Agonis parviceps*, 1.7.1993, PERTH 04259610.

Etymology: *viscidibrunnea* refers to the sticky brown basidiomes.

Pileus up to 40 mm broad, flat-convex with incurved margin. Soon slightly uplifted with depressed centre and undulating, translucent-striate margin. Various shades of orange-brown (5B6, 5C7-6D7), at first uniformly then paler at margin with age. Surface slimy, smooth. **Lamellae** decurrent, up to 3 mm deep, close or subdistant spacing. Lamellulae abundant (e.g. L:11, l:52), pale yellowish-grey (3B2), sometimes tinged pinkish-orange, edge smooth and entire, waxy. **Stipe** up to 62 x 5 mm, tapering upwards or broadest in middle region, hollow, slimy, slightly greyish green or yellow at apex, grading below to yellowish (4B4-4A6 or 5A6) or darker greyish-orange (5C6). **Flesh** same colour as surface, not bruising. **Basal mycelium** not conspicuous. **Odour** not distinctive. **Taste** none. **Spore deposit** white.

Spores hyaline in water and in KOH, with or without oil bubble, not amyloid, 7-9 (9.5) x 4.5-5.5 (6) µm, mean 8.0 x 4.8 µm (n = 55). Ellipsoid to broad ellipsoid in face view and in profile, smooth, thin-walled. **Basidia** 30-45 x 4-7 µm, cylindro-clavate to cylindric, hyaline, thin-walled, sterigmata very long (up to 18 µm) and narrow (1-1.5 µm), 4-spored, clamp connection at base.

Cheilocystidia 20-50 x 2-4 µm, branching hypha-like with flexuous or cylindrical end-cells. Hyaline (in KOH and Melzer's reagent), smooth, thin-walled, with associated glutinous material. Abundant, forming a broad sterile gill edge, clamp connections present. **Pleurocystidia**, and **Caulocystidia** none seen. **Hymenophoral trama** central region of sausage-like hyphae inflated up to 20 µm broad, and narrower, parallel-walled hyphae 4-6 µm broad. Outer region of greatly branched narrow hyphae 2-6 µm broad. All hyaline, smooth, thin-walled, clamp connections very rare. **Subhymenium** not differentiated, hyphae 1.5-3 µm broad, clamp connections present. **Pileipellis** an ixotrichoderm comprised of loosely arranged, branched, hyaline, smooth-walled hyphae (2-4 µm broad) infrequently with clamp connections, embedded in a hyaline gelatinous matrix, merging below with similar but broader hyphae (up to 8 µm broad) arranged more or less parallel to the surface. These in turn merge below with inflated elements (up to 30 µm broad) of the pileus trama. Inner pellis and trama with a pale orange pigment evident in water but not in KOH. **Stipitipellis** a similar ixotrichoderm. **Clamp connections** abundant on the gill edge but infrequent elsewhere.

Habitat and distribution On ground in peaty soil, in small groups. So far known only in south west Western Australia.

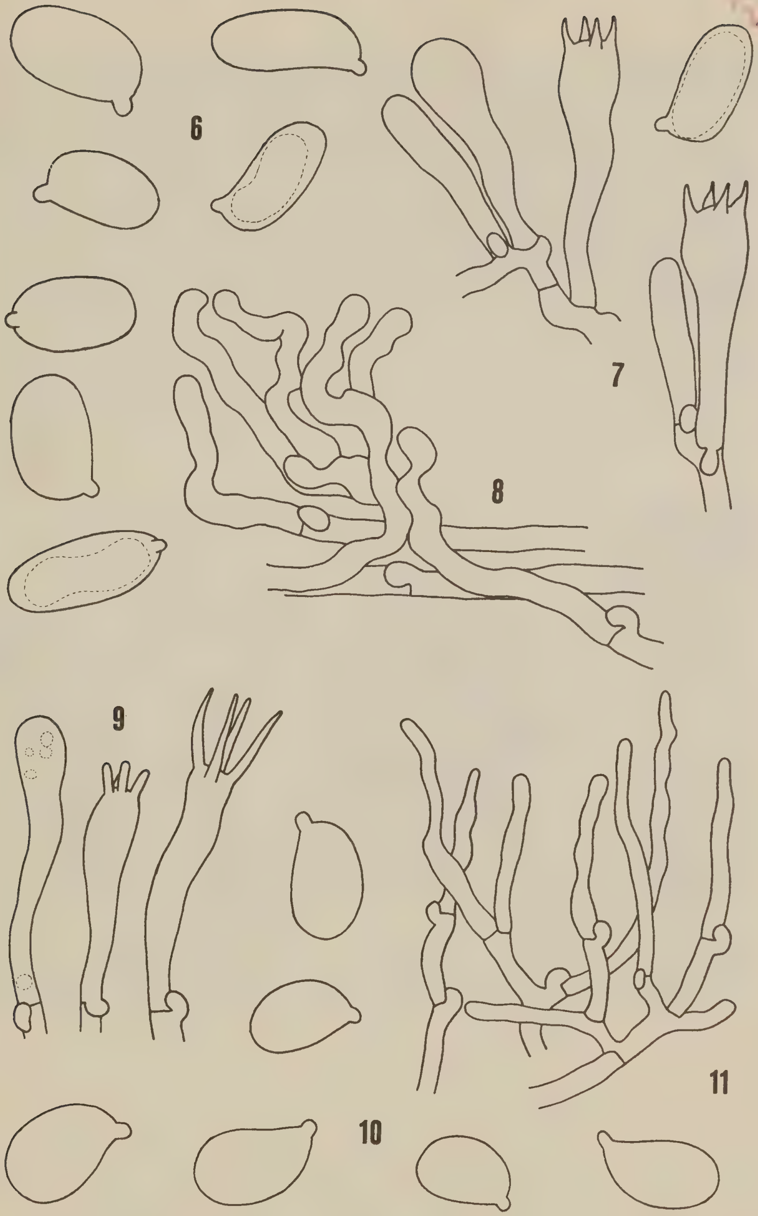
Collection detailed/illustrated Western Australia, west Denmark area, Lot 3298, in moist almost peaty soil near *Agonis juniperina*, & *Agonis parviceps*, 1 July 1993, coll. *A. & K. Syme KS 684/93* (holotype PERTH 04259610, isotype CSIRO E5627). **Other collections examined** Western Australia, Walpole-Nornalup National Park, in litter under *Eucalyptus jacksonii*, 9 June 1989, coll. *N. Bougher s.n.* (CSIRO E604, duplicate with O.K. Miller Virginia OKM 23861).

General notes

H. viscidibrunnea is characterised by its orange-brown, slimy cap, slimy stem, and pale decurrent gills. This fungus would be placed by some authors (e.g. Horak, 1990) in the genus *Gliophorus*, which we consider to be subordinate under *Hygrocybe*. *H. viscidibrunnea* is the first of this group to be found in W.A., and is closely related to *Hygrocybe batesii* A. M. Young *nom. prov.* from eastern Australia (Young, 1996). Other representatives of slimy *Hygrocybe* in Australia include the green species - *H. graminicolor* (E. Horak) May & Wood and *H. stevensoniae* May & Wood (synonymous with *Hygrophorus viridis* G. Stev.), and the yellow *H. chromolimonia* (G. Stev.) May & Wood (see photographs in Fuhrer & Robinson, 1992). These three species and ten others assigned to *Gliophorus* by Horak (1990) are known to occur in New Zealand. At least some of them might be expected to occur in Western Australia.

Figs. 6 - 8. *Hygrocybe polychroma* holotype : **6.** basidiospores (2000 X). **7.** basidia (1000 X). **8.** caulocystidia (1000 X).

Figs. 9 - 11. *Hygrocybe viscidibrunnea* holotype: **9.** basidia (1000 X). **10.** basidiospores (2000 X). **11.** cheilocystidia (1000 X).



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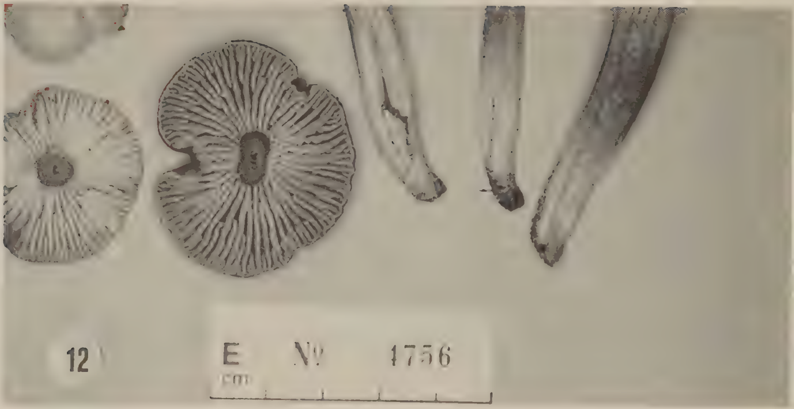
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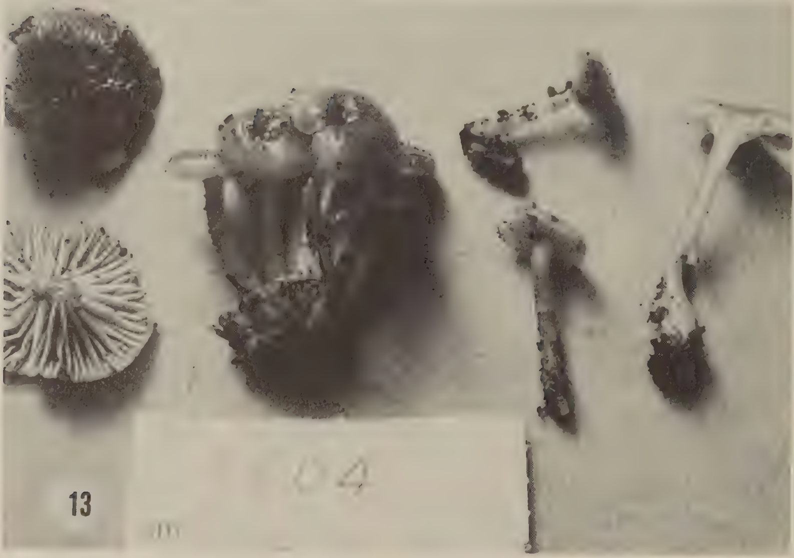

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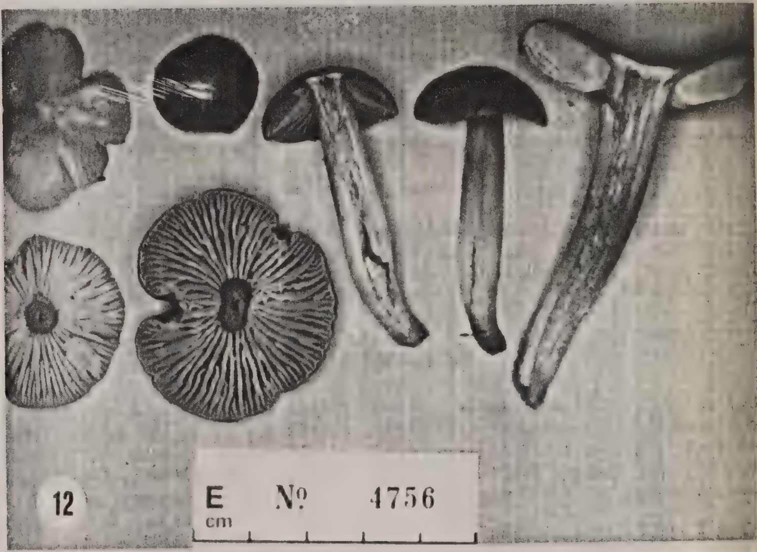
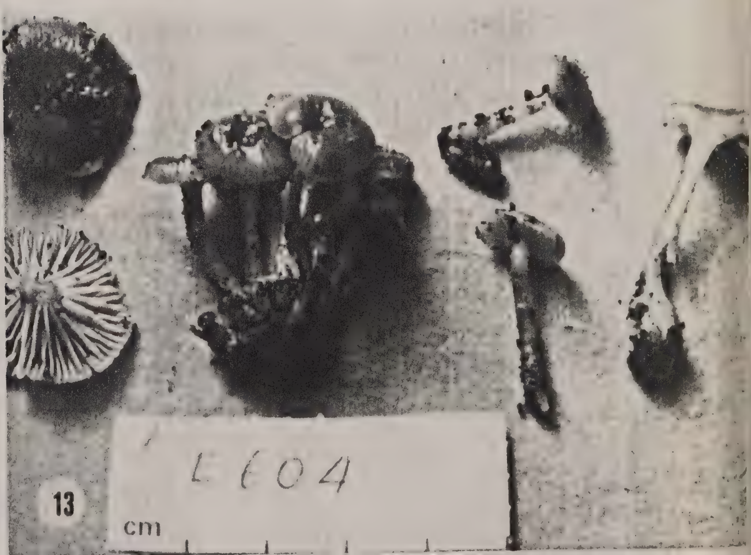
Page 34 [Replacement for figs. 12 & 13, N. L. Bougher and A. M. Young. "Hygrophoraceae of Western Australia"] **Fig. 12.** *Hygrocybe polychroma* basidiomes (holotype). **Fig. 13.** *Hygrocybe viscidibrunnea* basidiomes (CSIRO E604).





ACKNOWLEDGEMENTS

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LITERATURE CITED

ARNOLDS, E. (1990). Tribus Hygrocybeae. In: Bas, C., Kuyper, Th. W., Noordeloos, M.E., & E. C. Vellinga (eds.) Flora Agaricina Neerlandica. Vol. 2. Pp. 70-115. A.A. Balkema, Rotterdam.

BOUGHER, N. L. & K. SYME (1997). Fungi of south-west Australia. University of Western Australia Press, Perth. (In press).

FUHRER, B. A. & R. ROBINSON (1992). Rainforest fungi of Tasmania. CSIRO, Melbourne.

HILTON, R. N. (1982). A census of the larger fungi of Western Australia. J. Roy. Soc. W. Aust. 65: 1-15.

HILTON, R. N. (1988). A census of the larger fungi of Western Australia Part II. J. Roy. Soc. W. Aust. 70: 111-118.

HORAK, E. (1990). Monograph of the New Zealand Hygrophoraceae (Agaricales). N.Z. J. Bot. 28: 255-309.

KORNERUP, A. and J. H. WANSCHER (1978). Methuen Handbook of Colour. 3rd Ed. Methuen & Co. Ltd., London.

MILLS, A. and A. MONKS (1993). Unusual spore print colouration within the family Hygrophoraceae. Mycotaxon 46: 85-91.

YOUNG, A. M. (1996). The Hygrophoraceae of Eastern Australia. University of Queensland PhD Thesis. (Unpublished).

Fig. 12. *Hygrocybe polychroma* basidiomes (holotype).

Fig. 13. *Hygrocybe viscidibrunnea* basidiomes (CSIRO E604).

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THREE NEW SEQUESTRATE BASIDIOMYCETES FROM WESTERN AUSTRALIA

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ABSTRACT

Three new species of sequestrate (truffle-like) Basidiomycetes are described from southern high rainfall areas in south-west Western Australia: *Macowanites luteiroseus* (Russulales), *Thaxterogaster basipurpureum* (Cortinariales), and *Thaxterogaster luteirufescens* (Cortinariales).

INTRODUCTION

Sequestrate Basidiomycetes are truffle-like fungi, with underground or semi-underground basidiomes. Many of them are closely related to groups of mushroom-like Basidiomycetes. Sequestrate fungi do not forcibly discharge their spores, and are mostly dispersed by animals. In Australia, these fungi are a major source of food for some indigenous mammals such as woylies and potoroos (Claridge & May, 1994). Most sequestrate fungi are also presumed to have ectomycorrhizal associations with plants. Sequestrate Basidiomycetes are extremely diverse in Australian eucalypt forests and other vegetation types (see Beaton, Pegler & Young 1985 and preceding papers in that series). Most of these species are endemic to Australia. Examination of several thousand collections of sequestrate fungi obtained during collecting expeditions undertaken by the present author and colleagues during the past 10 years have revealed that sequestrate Agaricales, Russulales, and Cortinariales are particularly well represented (Castellano & Bougher 1994; Bougher 1995). In this paper three new putatively ectomycorrhizal Western Australian species are described: 1 from the Russulales - genus *Macowanites*, and 2 from the Cortinariales - genus *Thaxterogaster*. All are from wet eucalypt forests in southern high rainfall areas of Western Australia (W.A.). Colour illustrations of the fungi described in this paper are published in Bougher and Syme (1997).

METHODS

Basidiomes collected from the field were described, and then air-dried for later examination. Dried material was hydrated and examined in 3% KOH and Melzer's reagent. Microscopic characters were drawn with an Olympus drawing tube system. All spore measurements include the hilar appendix. Colour codes quoted are from Kornerup & Wanscher (1978). Specimens designated as H numbers are held at the CSIRO Division of Forestry, Perth, Western Australia.

DESCRIPTION OF THE SPECIES

Macowanites luteiroseus Bougher, sp. nov.

Figs. 1-6.

Pileus 8-35 mm latus, globosus vel hemisphaericus demum ellipsoideus ad plano-convexus, margo valde incurvatus. Color variabilis, exempli gratia omnino flavus vel cremeus vel lutescens clarus, luteus cum aliqui maculosus roseus pallus vel rosaceus omnino. Lamellae/Gleba laminare ad sublaminares, adnexae, usque ad 5 mm profundae, non plerumque aspectus verticales. Albae quum juvenes ad cremeae quum maturae. Stipes 5-22 x 3-7 mm, percurrens, cylindricus vel habens basum leviter clavatum, interior solidus ad medullosum (raro locellatum). Pagina omnino albus et non convertet quum maturus. Sporae hyalinae in KOH, amyloideae in solutio Melzer, (8) 8.5-10.5 x 6.5-8 μm, subglobosae vel late ellipsoideae, ornatae. Sporae nullae efferens. Basidia 34-55 x 10-13 μm, clavata vel ventricosa, tetraspora (aliquot 1, 2). Cheilocystidia 55-100 x 10-15 μm, fusiformia gracilia vel minor cylindrica. Pleurocystidia similis a cheilocystidia. Habitat sub ruderata sylvarum eucalyptarum humidarum in Australia occidentalis. Holotypus Australia occidentalis, Walpole-Nornalup National Park, in ruderata sylvae cum *Eucalyptus diversicolor* et *E. jacksonii*, 3.6.1995, PERTH.

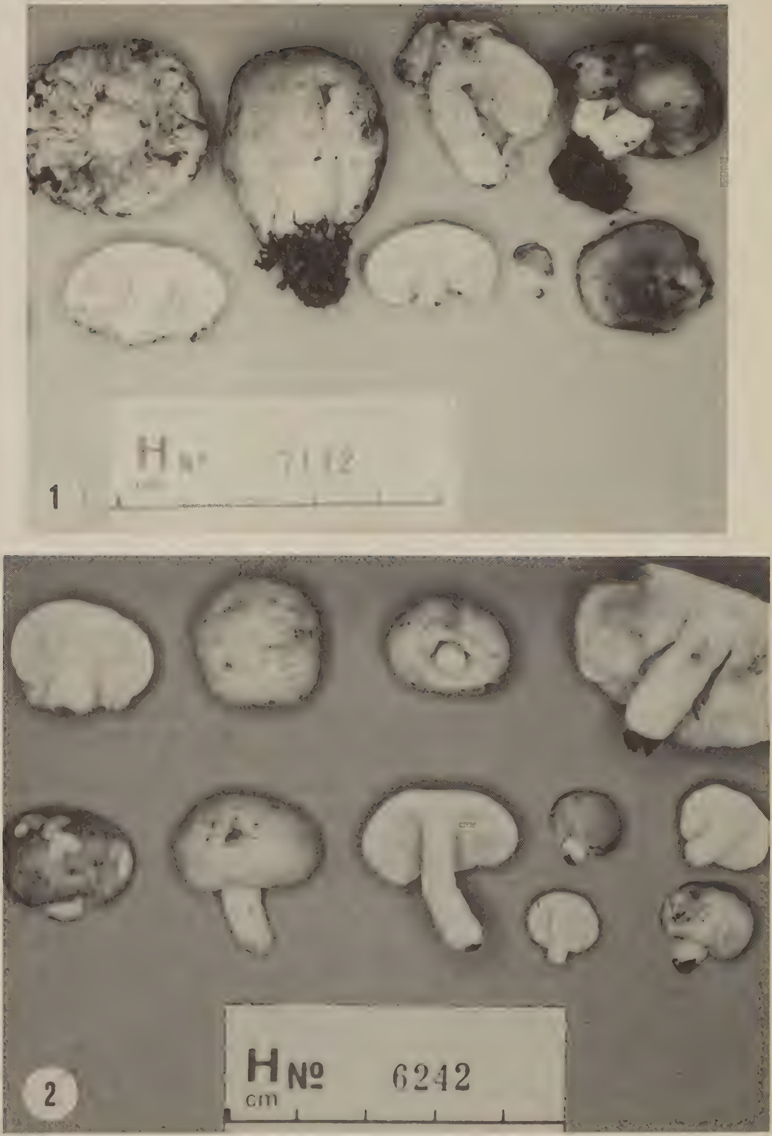
Etymology: *luteiroseus* refers to the yellow and rosy coloured basidiomes.

Pileus 8-35 mm broad, globose to hemispherical when as a button, expanding to broadly convex with strongly incurved margin, becoming ellipsoid or flat convex with a persistently incurved, entire margin which gradually recedes away from the stipe revealing the gleba to various degrees. Margin not translucent-striate. Colour variable: e.g. entirely pale yellow or cream (2A3) or brighter pastel yellow (3A4), yellow with some pale rosaceous mottles (8A3), or dominantly or entirely rosaceous (10C5). Sometimes the pigment becomes paler following heavy rainfall. Surface dry, very minutely soft velutinous when young (see under lens) becoming smooth, often with a white bloom (see under lens) when mature, sometimes cracking when older to expose areas of underlying white cap flesh. **Lamellae/Gleba** lamellate to sublamellate with few cross-walls, adnexed, up to 5 mm deep, very tightly packed and convoluted, not usually vertically orientated, 48-60 lamellae per half pileus, edge of lamellae smooth, entire at first but eroded with age, edge and face white when young maturing to cream (4A2), sometimes bruising red-brown. Latex absent. Gleba usually exposed to various degrees as the cap margin partially separates from the stipe, but in some specimens the cap margin may always remains clasped to the stipe. **Stipe** 5-22 x 3-7 mm, percurrent, cylindric or with slightly clavate base, interior solid then pithy (rarely chambered). Surface dry, minutely felty (see under lens), more or less finely longitudinally wrinkled when older, entirely white and unchanging with age. The stipe length varies such that it may emerge far beyond the cap like a mushroom or may not emerge at all. **Veil** absent. **Flesh** white, unchanging when cut. **Basal mycelium** white, sparse. **Odour** not distinctive. **Taste** mild. **Spore deposit** none produced. **Chemical spot tests** sulfovanillin red on the lamellae, gum guaiac slowly blue-green on the lamellae.

Spores hyaline in KOH or water, wall and ornamentation amyloid, (8) 8.5-10.5 x 6.5-8 mm, mean 9.2 x 7.1 mm (n = 60), thin-walled. Subglobose to broad ellipsoid in profile (some spores distinctly asymmetrical), similar or globose in face view. Ornamentation of irregularly shaped or labyrinthine warts (some up to 1 mm broad but often much smaller) as seen in face view, warts ranging from mainly isolated in some spores to mostly connected by fine lines in other spores, in profile the warts appear as numerous round-topped slightly tapering pegs 0.5-1 mm tall. Ornaments are uniformly distributed and of similar size over the entire spore, and usually not reduced as a plage in the suprahilar region. Hilar appendix oblique, tapering, up to 2 mm long. **Basidia** 34-55 x 10-13 mm, clavate to ventricose, hyaline, thin-walled, sterigmata up to 8 mm long, 4-spored (few 1, 2), clamp connection absent. **Cheilocystidia** 55-110 x 10-15 mm, smooth, thin-walled, hyaline except for a refractive pale yellow pigment in the cytoplasm near the apex, slender fusiform or less often cylindric with rounded or mucronate apex, abundant/crowded, mixed with basidia. Originating in the subhymenium, and projecting well beyond hymenium level. **Pleurocystidia** 58-125 x 12-23 mm, similar to cheilocystidia but shape more variable: e.g. slender fusiform, ventricose or near-cylindric with rounded or mucronate apex, abundant but separated singly along the gill. Originating in the subhymenium, projecting well beyond the level of the hymenium. **Caulocystidia** none seen (see notes on stipe pellis below). **Hymenial trama** hyaline in KOH, pale yellow in Melzer's reagent. Central strand narrow, composed of interwoven hyphae 2-6 mm broad, lateral regions predominantly sphaerocysts up to 20 mm broad, and relatively few hyphae. **Subhymenium** not well differentiated from the lateral tramal regions, composed of tightly packed globose and ellipsoid sphaerocysts up to 22 x 12 mm broad. **Pileipellis/ peridium** 80-175 mm broad, composed of cells up to 30 mm broad merging with the trama (some with thickened walls) giving rise to an outer narrow entangled trichoderm of smooth, thin-walled hyphae 2-5 mm broad with undifferentiated or slightly tapering end cells. Outer hyphae hyaline or pale yellow in KOH, golden yellow in Melzer's reagent. General pellis pigments: (a) from predominantly red basidiomes - dull reddish brown in water, yellow-brown in KOH, pink changing to golden yellow in Melzer's reagent. (b) from yellow basidiomes - pale yellow in water and in KOH, bright yellow in Melzer's reagent. **Stipitipellis** a well developed trichoderm of hyaline or pale yellow (in Melzer's reagent), smooth, thin-walled hyphae 3-6 mm broad, end-cells unswollen sometimes with a refractive pigment (similar to that of the gill cystidia). Subtended by cells up to 40 mm broad. **Clamp connections** absent.

Habitat and distribution Under the litter of wet eucalypt forests of south west W.A. Under *Allocasuarina decussata, Acacia* sp., *Eucalyptus diversicolor, E. guilfoylei, E. jacksonii.* In small or large groups.

Collections examined Western Australia, Walpole-Nornalup National Park, Nunn Road, in litter of forest with *Eucalyptus diversicolor* & *E. jacksonii*, 3 June 1995, coll. *K. Syme n.s.* (holotype PERTH 04259661, isotype at CSIRO H7142). Shannon River, turn-off to Northcliffe, in litter of *Eucalyptus diversicolor* forest, 18 June 1981, coll. *L. Sanfeliu n.s.* (CSIRO H119). Nornalup, Valley of the Giants forest, junction of Old Valley Rd, Picnic Rd., and Rates Rd, in litter of forest with *Eucalyptus diversicolor, E. jacksonii, E. guilfoleyi*, & *Allocasuarina decussata*, 7 June 1992, coll. *N. Bougher & K. Syme n.s.* (CSIRO H6241). Nornalup, Valley of the Giants forest, Old Valley Rd, in litter of forest with *Eucalyptus diversicolor, E. jacksonii, E. guilfoleyi*, & *Allocasuarina decussata*, 7 June 1992, coll. *K. Syme n.s.* (CSIRO H6242). Walpole-Nornalup National Park, Cemetery Rd., in litter of forest with *Eucalyptus diversicolor* & *E. jacksonii*, 13 July 1994, coll. *T. Lebel, M. Brundrett, D. Brown n.s.* (CSIRO H6683). Walpole-Nornalup National Park, The Knoll, in litter of forest with *Eucalyptus diversicolor* & *E. calophylla*, 14 July 1994, coll. *N. Bougher n.s.* (CSIRO H7020). Walpole-Nornalup National Park, Gully Rd., in litter of forest with *Eucalyptus jacksonii* & *E. marginata*, 4 June1995, coll. *N. Bougher & M. Alosi n.s.* (CSIRO H7151).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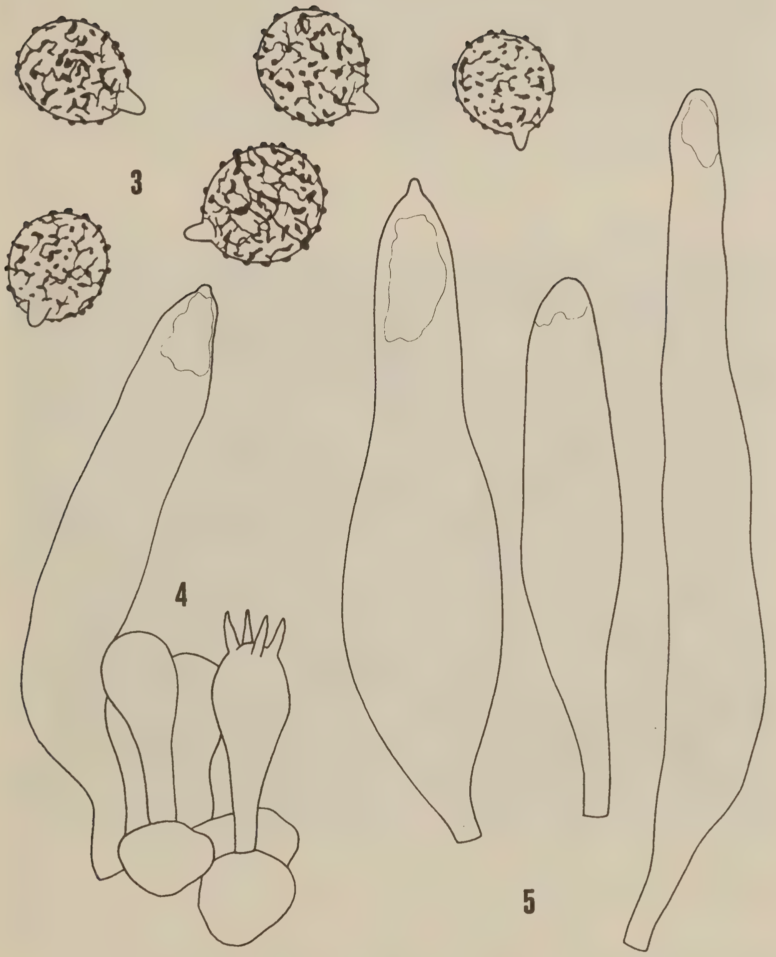
Figs. 1 - 2. *Macowanites luteiroseus* basidiomes: **1.** type collection **2.** CSIRO H6242.



Figs. 3 - 5. *Macowanites luteiroseus* holotype: **3.** basidiospores (2000 X). **4.** hymenium with a cheilocystidium and basidia (1000 X). **5.** pleurocystidia (1000 X).

General notes
Macowanites luteiroseus is a common and abundant fungus of Karri (*Eucalyptus diversicolor*) and Tingle (*E. jacksonii, E. guilfoylei*) forests of south-west Western Australia but is easily overlooked as its basidiomes are usually hidden under the leaf litter. This species resembles a small, distorted or aborted *Russula* - i.e. cap which never fully expands, short white percurrent stipe which often remains enveloped by the cap, and tightly packed/contorted white gills which do not yield a spore print. The basidiomes of *Macowanites luteiroseus* have various colours: e.g. entirely pale yellow or cream, yellow with rose mottles, or entirely rose. All such colours can be represented among basidiomes occurring in the same fruiting patch. Dried specimens retain the yellow and red colouration. About 20 species of *Macowanites* are known throughout the world, but none in Australia had previously been assigned to the genus. However, our collecting expeditions throughout Australia over the past ten years have yielded a large range of *Macowanites* species, of which *M. luteiroseus* is the first to be formally named.

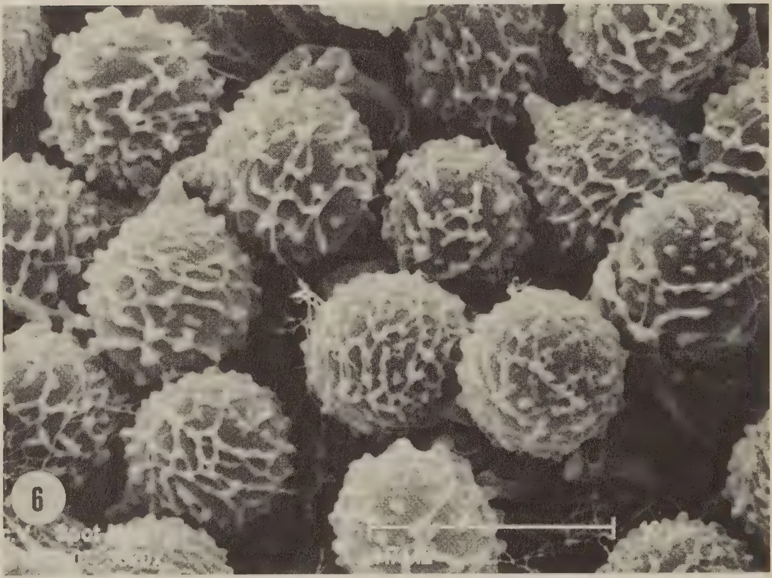


Fig. 6. *Macowanites luteiroseus* holotype: scanning electron image of basidiospores.

Thaxterogaster basipurpureum Bougher, sp. nov.

Figs. 7, 9, 10.

Basidiomata 5-15 mm alta x 8-25 mm lata, globosa, subglobosa vel pyriformes. Peridium crassum, valde glutinosum, verrucosum sub mucus, griseo-brunneum vel roseo/purpureo-brunneum. Gleba sicca, loculata, irregularis, brunnea. Columella percurrens vel truncata. Stipes parvus, brevis, textura basalis purpurea. Sporae ferrugineae in KOH, (10) 10.5-12.5 (13) x 7.5-9 mm, late ovatae vel late obpyriformes, symmetricae, grosse verrucosae, perisporium adhaerens. Basidia 33-65 x 7-11 mm, cylindracea vel to cylindro-clavata, hyalina, tetraspora. Cystidia nulla. Peridiopellis gelatinosus. Fibulae absentes. Habitat hypogeous sub *Gastrolobium*, *Eucalyptus*, *Agonis*, et *Allocasuarina*, Australia occidentalis. Holotypus Australia occidentalis, Two People's Bay, sub *Gastrolobium*, 31.7.1995, PERTH.

Etymology: *basipurpureum* refers to the concentrated purple colour near the base of the basidiomes.

Basidiomes globose, ellipsoid to pyriform, 5-15 tall x 8-25 mm broad. **Peridium** thick (about 1 mm), two layers: inner layer greyish and not gelatinised, outer layer broader and gelatinised. Surface thick-slimy (not sticky) often covered with adhering soil and debris, stippled with dome-shaped bumps underneath the slime. Cream to pale tan (4B4-5B4) when young then darkening to grey-brown or reddish/purplish-brown (6F7-7F7 or 10E5) or sometimes grey-violet (duller than 17B3). Not bruising. The peridium is often pleated around the stipe. **Gleba** dry, with irregular empty large locules to 1 mm broad, noticeably radially elongated in some specimens, cream maturing to dark brown (6E8-7F8). Trama pale cream. **Columella** usually percurrent or less often truncate, up to 6 mm broad in the gleba and there whitish or dull in section. Emerging as a tapering stipe up to 3 mm long x 5 mm wide with whitish, minutely pubescent, dry surface. Where it meets the peridium the stipe is encircled by a thick collar of slime which is purplish at least when young. **Flesh** conspicuously bright purple (17E8) in section especially near the base of the stipe. **Basal mycelium** whitish, but not conspicuous. **Odour** similar to camphor or mothballs. **Taste** none.

Spores bright brown in KOH, (10) 10.5-12.5 (13) x 7.5-9 mm, mean 11.0 x 8.5 mm (n = 30). Broad ovoid to broad obpyriform in face view and profile (axially symmetrical). Coarsely warty with irregular, crowded warts appearing in profile as flat-topped pegs up to 2 mm tall x 1 mm broad. Perisporium adhering closely to the ornamentation, yellowish in KOH, also covering the apex. Hilar appendix broad (to 2 mm) but short, truncate, sometimes with a hyaline peg attached. **Basidia** 33-65 x 7-11 mm, cylindric to cylindro-clavate, hyaline, thin-walled, 4-spored, clamp connection absent. **Cystidia** absent. **Hymenial trama** parallel hyaline or yellow-encrusted, hyphae (3-15 mm broad), without clamp connections. The hyphae may inflate (to 35 mm broad) in older specimens. **Subhymenium** not differentiated. After the basidia have collapsed the hymenial elements may inflate to become vesiculose (up to 25 x 20 mm). **Peridium** outer broad layer of hyaline, thin-walled hyphae (2-7 mm broad) loosely arranged in a hyaline matrix. Inner layer of thicker walled, hyphae (4-10 mm broad), heavily encrusted with a bright golden yellow (in KOH) wall pigment. Hyphae sometimes appear as polygonal cells, and the pigment is concentrated in clusters. **Clamp connections** absent.

Habitat and distribution Buried in the ground under litter of wet *Eucalyptus* forests and *Gastrolobium* thickets. This fungus is locally abundant along the south coastal area of W.A.

Collections examined Western Australia, Two People's Bay Nature Reserve, Hakea Gully, in thicket dominated by *Gastrolobium* sp., 31 July 1995, coll. *A. Danks s.n.*, (holotype PERTH 04259629, isotype at CSIRO H7302). Walpole-Nornalup National Park, The Knoll, under *Eucalyptus calophylla* & *Agonis flexuosa*, 6 June 1992, coll. *K. Syme* & *N. Bougher s.n.* (CSIRO H6235). Walpole-Nornalup National Park, Shedley Drive, under *Eucalyptus jacksonii* & *Allocasuarina decussata*, 6 June 1992, coll. *N. Bougher & K. Syme s.n.* (CSIRO H6236). Nornalup, Valley of the Giants forest, corner of Thompson Rd & Rates Rd, in litter of forest with *Eucalyptus jacksonii*, 14 July 1994, coll. *N. Bougher, D. Brown & T. Lebel n.s.* (CSIRO H6684). Two People's Bay Nature Reserve, Hakea Gully, in thicket dominated by *Gastrolobium* sp., 31 July 1995, coll. *A. Danks s.n.*, (CSIRO H7303). People's Bay Nature Reserve, Firebreak Gully, under *Agonis flexuosa*, 21 August 1991, coll. *K. Syme KS338/91*, (CSIRO H6255).

General notes

Thaxterogaster basipurpureum is characterised in the field by its thick, very slimy, bumpy, purplish- or reddish-grey peridium, and bright purple inside the lower part of the stipe columella. Microscopically, it has axially symmetrical and coarsely warted spores, and has no clamp connections on the hyphae. We have collected this species over many years in the south coast area of W.A., but have not observed it elsewhere in Australia. *Thaxterogaster basipurpureum* has been collected in close proximity to a wide variety of mycorrhizal plants, including *Gastrolobium* sp., *Agonis flexuosa*, *Eucalyptus calophylla*, *E. diversicolor*, and *Allocasuarina decussata*.

Thaxterogaster luteirufescens Bougher, sp. nov.

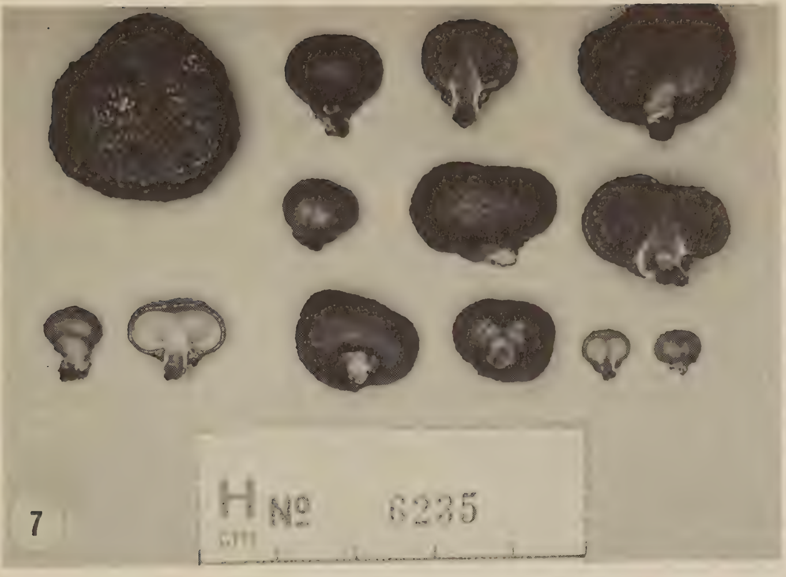
Figs. 8, 11-13.

Basidiomata globosa vel ellipsoidea lata, usque ad 20 mm lata. Peridium crassum (circa 1 mm), pagina mucosa (non glutinosa), lutea ad aurantiaca cum labes croceo-lutea in panni parvi. Gleba sicca, habens loculi irregulari grandi vacci ad 0.5 mm latus, elongata radialis non notatio, cinnamomi. Columella plerumque ad acumen angustata, vel percurrens, alba in sectionem. Basum/caulis brevissimus emergens. Sporae cinnamoneae in KOH, 12-14.5 x 7.5-8.5 µm. Ovoideae ad ellipsoideae, verruciformes. Basidia 50-83 x 8-16 µm, cylindrica ad cylindro-clavata, hyalina, habens paries tenues, tetraspora. Cystidia nulla. Peridiopellis stratum exterior habens hyphae angustae hyalinae (3-5 µm latus), in matricem hyalinam laxe ordinatant. Stratum interior habens hyphae latae (ad 22 µm latus) et cellae polygonae (ad 30 µm latus) habens paries crassi et cum pigmentum. Fibulae raro in peridium. Habitat in terram sub ruderata sepelit, meridionalis Australia occidentalis. Holotypus Australia occidentalis, Walpole-Nornalup National Park, sub *Eucalyptus ficifolia*, PERTH.

Etymology: *luteirufescens* refers to the yellow and orange-red stained basidiomes.

Basidiomes globose or broad ellipsoid, up to 20 mm broad. **Peridium** thick (about 1 mm), whitish in section but dulling when cut. Surface slimy (not sticky). Yellow with a hint of orange

Fig. 7. *Thaxterogaster basipurpureum* basidiomes CSIRO H6235.
Fig. 8. *Thaxterogaster luteirufescens* basidiomes type collection.



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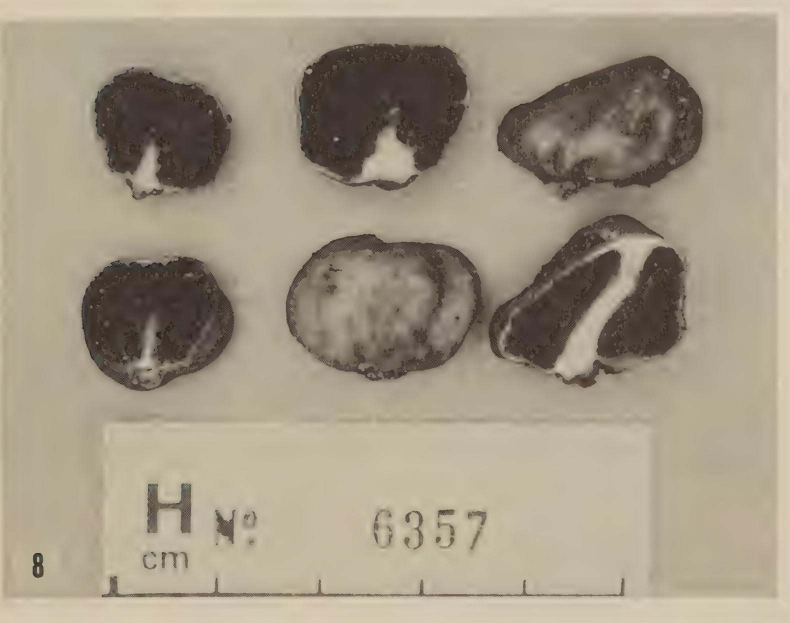

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(4A6-4B7) with orange-red (6B8 or 7B8) stains in small patches. Peridium sometimes pleated around the stipe where a collar of reddish slime occurs. **Gleba** dry, with irregular empty large locules to 0.5 mm broad, not noticeably radially elongated, fairly bright brown (7E8-8F7). Trama whitish. **Columella** either tapering to a point about a third or a half of the way up into the gleba, or percurrent and then up to 2-3 mm broad. White in section. Also with a very short (up to about 1 mm long), tapering or bulbous, emergent reduced stipe. This has a dry, matted-fibrillose, pale dull yellow surface. **Flesh** dull brown in the base, paler elsewhere. **Basal mycelium** not conspicuous. **Odour** none. **Taste** none.

Spores bright brown in KOH, 12-14.5 x 7.5-8.5 mm, mean 13.1 x 8.1 mm (n = 30). Ovoid to ellipsoid in face view and profile (some very slightly axially asymmetrical). Warty with densely arranged, irregular, warts appearing in profile as flat-topped pegs up to 1 mm tall. Perisporium adhering closely to the ornamentation, pale yellowish in KOH, also covering the apex. Hilar appendix large, tapering, truncate. **Basidia** 50-83 x 8-16 mm, cylindric to cylindro-clavate, hyaline, thin-walled, 4-spored, with a small clamp connection at the base. **Cystidia** absent. **Hymenial trama** parallel hyaline and brown-encrusted, hyphae (3-8 mm broad), with clamp connections. Some oeliferous hyphae present. **Subhymenium** of broad, hyaline hyphae and cells (to 15 mm broad). After the basidia have collapsed the hymenial elements may inflate up to 40 mm broad. **Peridium** outer layer of narrow, hyaline hyphae (3-5 mm broad), mainly without clamp connections, some with minute hyaline wall ornamentation, loosely arranged in a hyaline matrix. Inner layer of broad hyphae (to 22 mm broad) and polygonal cells (to 30 mm broad), thick-walled and very heavily encrusted with a golden brown (in KOH) pigment. **Clamp connections** present in the hymenium, but rare in the peridium.

Habitat and distribution Buried in the ground under litter. Collected several times under various *Eucalyptus* species - e.g. *E. ficifolia*, *E. calophylla* - in south coastal area of W.A.

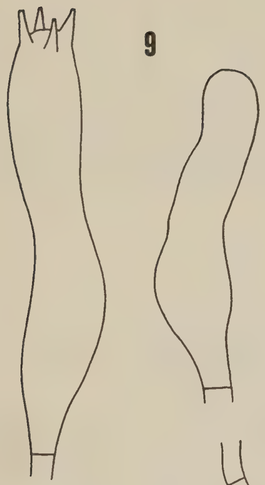
Collections examined Western Australia, Walpole-Nornalup National Park, Nut Road, under *Eucalyptus ficifolia*, 10 June 1993, coll. N. Bougher *s.n.* (holotype PERTH 04259599, isotype at CSIRO H6357). Two People's Bay Nature Reserve, Firebreak Gully, under *Eucalyptus calophylla*, 13 August 1991, coll. K. Syme *KS331/91* (CSIRO H6254).

General notes

Thaxterogaster luteirufescens may be recognised in the field by its thick, slimy peridium which is yellow with orange-red stains in patches. It is placed in the genus *Thaxterogaster* rather than in *Protoglossum* (formerly *Cortinomyces*) because at least some specimens found so far have a percurrent stipe columella, and the spores are slightly asymmetric. However, a case could be made to include this fungus in either genus, and it highlights the indistinct boundary between the two genera. The basidiomes, peridial structure, and spores of *T. luteirufescens* are similar to those of *T. aurantiacum* Horak from under *Leptospermum* in New Zealand (Horak 1973). However, *T. aurantiacum* differs by having a more pronounced marginate bulb, and clamp connections in the peridium.

Figs. 9 - 10. *Thaxterogaster basipurpureum* holotype. **9.** basidia (1000 X). **10.** basidiospores (2000 X).

Figs. 11 - 13. *Thaxterogaster luteirufescens* **11.** basidiospores (2000 X) holotype. **12.** structure of the peridium (CSIRO H6254, bar = 20 mm). **13.** basidium (1000 X) holotype.



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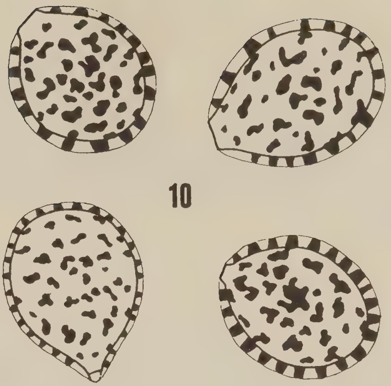

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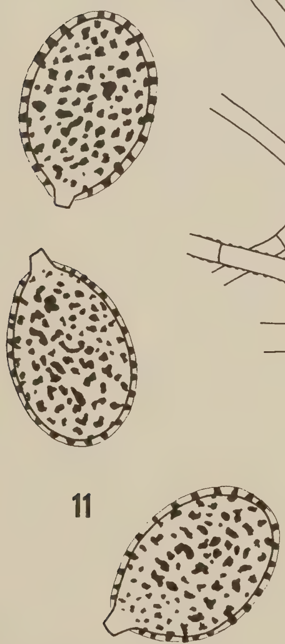

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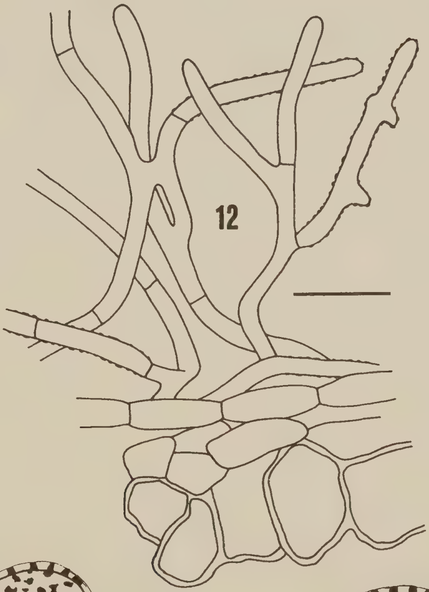

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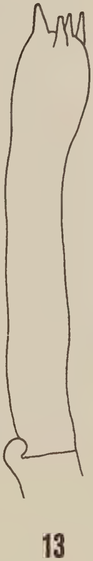

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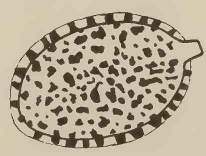

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LITERATURE CITED

BEATON, G., PEGLER , D. N. and T. W. K. YOUNG (1985). Gasteroid Basidiomycota of Victoria State, Australia. 8-9. Kew Bulletin 40: 827-842.

BOUGHER, N. L. (1995). Diversity of Ectomycorrhizal Fungi associated with Eucalypts. In: Mycorrhizas for Plantation Forestry in Asia. (Eds.: M. Brundrett, B. Dell, N. Malajczuk, & G. Mingqin) Proceedings No. 62. Australian Centre for International Agricultural Research, Canberra Pp. 8-15.

BOUGHER, N. L. and K. SYME (1997). Fungi of south-west Australia. University of Western Australia Press, Perth. (In press).

CASTELLANO, M. A. and N. L. BOUGHER (1994). Consideration of the taxonomy and biodiversity of Australian ectomycorrhizal fungi. Plant & Soil 159:37-46.

CLARIDGE, A. W. and T. W. MAY (1994). Mycophagy among Australian mammals. Australian Journal of Ecology 19: 251-275.

HORAK, E. (1973). Fungi Agaricini Novaezelandiae II. *Thaxterogaster*. Beihefte Nova Hedwigia 43: 87-114.

KORNERUP, A. and J. H. WANSCHER (1978). Methuen Handbook of Colour. 3rd Ed. Methuen & Co. Ltd., London.

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TWO NEW SPECIES AND NEW REPORTS IN THE PARMELIACEAE SENSU STRICTO (LICHENIZED ASCOMYCOTINA) FROM BRAZIL

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ABSTRACT: *Parmotrema lichexanthonicum* Eliasaro & Adler and *Rimelia succinreticulata* Eliasaro & Adler are described as new. New records are reported for three species of *Bulbothrix* Hale, three species of *Hypotrachyna* (Vain.) Hale and one of *Relicina* (Hale & Kurok.) Hale.

The present study is based on specimens collected mainly by the first author and are kept, unless stated otherwise, at UPCB. The abbreviations for names of herbaria correspond to the "Index Herbariorum" (Holmgren et al., 1990). Lichen substances were identified by TLC (Elix, Johnston & Parker, 1987) and by comparison with authentic samples.

Parmotrema lichexanthonicum Eliasaro & Adler sp. nov. **Fig. 1**

Species cum thallo et substantiis ut in *Parmotrema ultralucens* sed ab hac specie absentia isidiorum et apotheciis perforatis differt.
Typus: **BRAZIL**. **Minas Gerais**. Santana do Riacho, Alto Palácio, Serra do Cipó, 19°22′ S, 43°32′ W; saxicolous in "campo rupestre", 1 February, 1989, *Eliasaro* (UPCB 24699-holotype; BAFC 37875, CANB-isotypes).

Thallus saxicolous, grey, loosely attached to the substrate, up to 10 cm across. Lobes subirregular, elongate with rounded apices, 7-15 mm wide, 10-25 mm long, with ciliate margins; cilia up to 0.5 mm long. Upper surface faintly maculate. Medulla white. Lower surface black, dark brown below the apices of the lobes, densely rhizinate to the margins in some young lobes or a bare to papillate zone present at the apices, commonly erhizinate to the centre, rhizines concolorous, mainly simple. Apothecia up to 5 mm

diam., disc brown, perforate, margin and thalline exciple smooth; asci clavate, 8-spored, ascospores hyaline, ellipsoid, 10-11 x 14.5-16 μm. Pycnidia laminal, immersed, mostly grouped in submarginal areas; conidia short filiform, 6.5-7 μm long.
Chemistry: Upper cortex K+ yellow (atranorin, major). Medulla K+ yellow turning red (salazinic acid, major), C-, KC-, UV+ bright yellow (lichexanthone, major).

The specific epithet refers to the presence of lichexanthone in the medulla.

Remarks: This species is closely related to the isidiate *Parmotrema ultralucens* (Krog) Hale (Krog, 1974, Hale, 1974, Krog et al., 1981, Elix, 1994) which also contains salazinic acid and lichexanthone in the medulla and atranorin in the upper cortex. The main taxonomic difference between the species is the absence of isidia in *P. lichexanthonicum*. The new species is also distinguished by the presence of apothecial perforations, a smooth exciple and faint maculation on the upper surface. In spite of these minor differences it could well be considered the parent species of *P. ultralucens*.

At present *P. lichexanthonicum* is only known from the Serra do Cipó, Minas Gerais, Brazil.

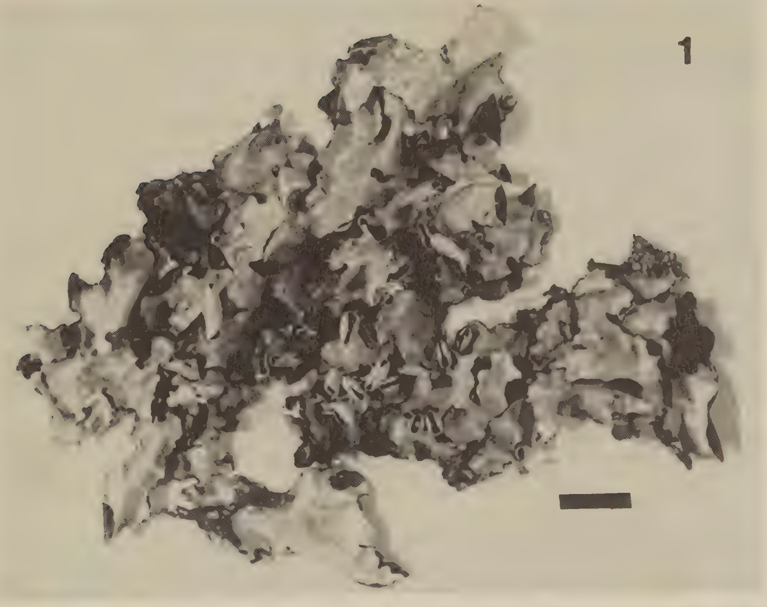
Rimelia succinreticulata Eliasaro & Adler sp. nov. **Fig. 2**

Specie cum thallo ut in *Rimelia simulans* sed ab hac specie acidum succinprotocetraricum et acidum fumarprotocetraricum continente differt.
Typus: **BRAZIL. Paraná**. Jaguariaíva, Parque Estadual do Cerrado, 24°08′ S, 49°44′ W, corticolous, 16 April, 1994, *Eliasaro 1268* (UPCB 24709-holotype, BAFC 37876-isotype).

Thallus grey or greenish-grey, up to 10 cm across, corticolous, sorediate, soralia mainly marginal, capitate or subcapitate, occasionally submarginal and punctiform. Lobes subirregular, laciniate in some parts, 3-10 mm wide, with ciliate margins; cilia black, slender, up to 1 mm long. Upper surface markedly reticulately maculate and cracked. Medulla white. Lower surface black, moderately rhizinate, with a broad, brown or mottled, bare marginal zone at the lobe apices, or rhizinate to the margin; rhizines black, mostly simple but commonly squarrosely branched, sometimes very long (up to 2 mm). Mature apothecia not seen. Pycnidia frequent, laminal, immersed, mostly grouped in submarginal areas; conidia filiform, (9-) 10-11 (-12) μm long.
Chemistry: Upper cortex K+ yellow (atranorin, major). Medulla K+ faint yellow turning orange, C-, KC+ faint yellow (succinprotocetraric acid, major; fumarprotocetraric acid, major; and protocetraric acid, trace).

Fig. 1.- Holotype of *Parmotrema lichexanthonicum* (UPCB 24699). Scale = 1.3 cm.

Fig. 2.- Holotype of *Rimelia succinreticulata* (UPCB 24709). Scale = 1 cm.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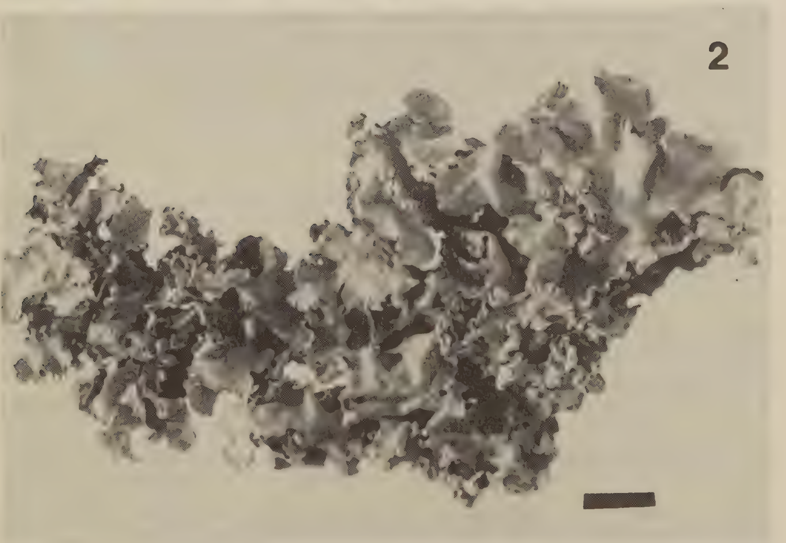
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Additional specimens examined: **BRAZIL**. **Paraná**. Tibagi, Guartelá, 25°32′ S, 50°19′ W, corticolous, 17 April 1994, *Eliasaro 1323* (UPCB 24712, CANB); Ponta Grossa, Parque Estadual de Vila Velha, saxicolous, 27 September 1995, *Bündchen 60* (H); Lapa, Parque Estadual Gruta do Monge, saxicolous, 6 February 1996, *Eliasaro 1729* (H).

The specific epithet refers to the presence of succinprotocetraric acid in the medulla and the reticulate pattern of maculae and cracks on the upper surface, typical of the genus *Rimelia* (Hale et. al., 1990).

Remarks: *R. succinreticulata* is a sorediate species, morphologically very similar to *R. simulans* (Hale) Hale & Fletcher and *R. reticulata (Tayl.)* Hale & Fletcher but differing from both in the major medullary substances, namely succinprotocetraric and fumarprotocetraric acids instead of caperatic acid (*R. simulans*) or salazinic acid (*R. reticulata*).

R. succinreticulata is so far only known from the "Segundo Planalto" of the State of Paraná.

NEW RECORDS

Bulbothrix hypocraea (Vain.) Hale, Phytologia **28**: 480. 1974.

Thallus adnate, mineral grey, 2-5 cm across. Lobes sublinear, irregularly branched, 0.5-0.8 mm wide, 0.5-0.6 mm long, with ciliate margins, cilia bulbate, commonly only present at the base of the lobes. Upper surface plane, maculate. Medulla white. Lower surface pale brown. Apothecia sessile, disc brown, 1-4 mm diam., the margin not coronate; ascospores hyaline, ellipsoid, 5-6 x 8-11.5 µm. Pycnidia not seen.
Chemistry: Upper surface K+ yellow (atranorin, major to minor). Medulla K+ yellow turning red (salazinic acid, major; norstictic acid, minor).

Specimens examined: **Paraná**. Jaguariaíva, Parque Estadual do Cerrado, 24°08′, 49°44′ W, 16 April 1994, *Eliasaro 1265, 1267* (UPCB 24301, 24300); **Tocantins**. Lizarda. Fazenda Morro Redondo, 09°34′ S, 46°43′ W, 600 m.s.m.; 18 August 1992, *Eliasaro 929* (UPCB 21813).

Remarks: The African and Brazilian (Hale, 1976) species *B. hypocraea* was formerly known from the States of Mato Grosso, São Paulo and Minas Gerais and is here recorded for the first time for Paraná and Tocantins.

Bulbothrix isidiza (Nyl.) Hale, Phytologia **28**: 480. 1974.

Thallus greenish-grey, 4-5 cm across. Lobes subirregular, 8-10 mm wide, with ciliate margins, cilia bulbate, mainly at the lobe axils, frequently only present at the bases of the lobes. Upper surface plane, maculate, densely isidiate, isidia simple to branched. Medulla white. Lower surface pale brown, moderately rhizinate, rhizines brown, simple. Apothecia and pycnidia not seen.

Chemistry: Upper surface K+ yellow (atranorin, major). Medulla K+ yellow turning red (salazinic acid, major).

Specimens examined: **Paraná**. Jaguariaíva, Parque Estadual do Cerrado, 24°08′ S, 49°44′ W, 16 April 1994, *Eliasaro 1264a* (UPCB 24705); Curitiba, Centro Politécnico, 25°26′ S, 49°18′ W, 3 August 1993, *Eliasaro 1021* (UPCB 22151).

Remarks: *B. isidiza*, a pantropical species (Hale, 1976), formerly known from the Brazilian States of Mato Grosso, Mato Grosso do Sul, Pará, São Paulo and Rio de Janeiro, is here reported for the first time from the State of Paraná.

Bulbothrix ventricosa (Hale & Kurok.) Hale, Phytologia **28**: 481. 1974.

Thallus greenish grey, adnate, 2-4 cm. across. Lobes subirregular, 1-3 mm wide, with ciliate margin, cilia conspicuous, with bulbate base. Upper surface plane, slightly maculate or not, moderate to densely isidiate. Medulla white. Lower surface dark brown to black, moderately rhizinate, rhizines black, simple. Apothecia and pycnidia not seen.
Chemistry: Upper cortex K+ yellow (atranorin, minor). Medulla K+ yellow turning red (norstictic acid, major).

Specimens examined: **Paraná**. Curitiba, Parque Barigui, 25°26′ S, 49°18′ W, 800 m.s.m, corticolous, 8 March 1994, *Eliasaro 1202, 1212, 1221* (UPCB 24706, 24707, 24716).

Remarks: *B. ventricosa* was formerly known from Mexico, Central America, Venezuela, South Africa and Brazil (Pará). Its distribution is here extended to the State of Paraná.

Hypotrachyna dentella (Hale & Kurok.) Hale, Smithsonian Contrib. Bot. **25**: 33. 1975.

Thallus saxicolous or corticolous, loosely attached, light greenish-grey, 4 cm across. Lobes irregular and imbricate, 2-3 mm wide. Upper surface plane, isidiate, isidia cylindrical, erect, brownish apically, simple at first but becoming branched at maturity. Medulla white. Lower surface black, moderately rhizinate, rhizines concolorous, dichotomoustly branched. Apothecia and pycnidia nor seen.
Chemistry: Upper cortex K+ yellow (atranorin, major). Medulla K+ orange, C+ KC (echinocarpic acid, major; barbatic acid, minor; and 4-0-demethylbarbatic acid, minor).

Specimens examined: **Minas Gerais**. Belo Horizonte. Parque Municipal, 19°53′ S, 43°56′ W, corticolous, 31 May 1993, *Eliasaro 992* (UPCB 24811). **Rio de Janeiro**. Petropolis. *Deventer* (G, lectotype by Hale of *Parmelia laevigata* var. *ceratina* = *P. dentella* Hale & Kurok.).

Remarks: *H. dentella*, formerly known from the USA, Mexico, Venezuela and Brazil (States of Rio de Janeiro and Rio Grande do Sul) is here recorded for the first time for the State of Minas Gerais.

Hypotrachyna flavida (Zahlbr.) Hale, Smithsonian Contrib. Bot. **25**: 37. 1975.

Thallus adnate, yellowish-green. Lobes sublinear, short, 0.4-1.3 mm wide. Medulla white. Lower surface black, rhizinate to the margin, rhizines dichotomously branched. Apothecia laminal, sessile, disc brown, 2-4 mm diam., ascospores 4-6 x (6-) 7-11 µm. Pycnidia not seen.
Chemistry: Upper cortex K- (usnic acid, major). Medulla K-, C-, KC- (protocetraric acid, major; physodalic acid, major; and an unidentified depside).

Specimens examined: **Paraná**. Tibagi. Guartelá, 25°32′ S, 50°19′ W, 17 April 1994, *Eliasaro 1316, 1317, 1318* (UPCB 24713, 24714, 24715).

Remarks: *H. flavida,* formerly known from Colombia, Venezuela, Peru and Brazil (States of Bahia, Minas Gerais and Rio de Janeiro), is here reported for the first time for Paraná.

Hypotrachyna silvatica (Lynge) Hale, Smithsonian Contrib. Bot. **25**: 63. 1975.

Thallus corticolous, pale grey, tightly attached, 2-3 mm across. Lobes sublinear, (0.5-) 1-0.8 (-2) mm wide, subdichotomously branched, with truncate apices. Upper surface plane, emaculate. Medulla white in the upper side, reddish-orange in the lower half. Lower surface black, moderately rhizinate, rhizines simple to rarely dichotomously branched. Apothecia common, with crenate margin, sessile, up to 5 mm diam., disc light brown; ascospores hyaline, ellipsoid, 5-7 x 9.5-12 µm. Pycnidia laminal, immersed, conidia bifusiform, 6-6.5 µm long.
Chemistry: Upper cortex K- (lichexanthone, major). Medulla K- to slightly K+ yellow in the upper half (protocetraric acid, major), K+ purple in the lower half (unidentified anthraquinone, major).

Specimens examined: **Mato Grosso**. Santa Anna da Chapada, *Malme 2393** (S, lectotype by Hale of *Parmelia silvatica* Lynge), Malme (S, lectotype by Hale of *P. crustacea* Lynge), *Malme 2393**** (S, lectotype by Hale of *P. silvatica* var. *pinnata* Lynge), *Malme 2393*** (S, lectotype by Hale of *P. silvativa* var. *radiata*); Serra da Chapada, Buriti, *Malme* (S) in Lichenes Austroamericani 87. **Paraná**. Tibagi. Canion Guartelá, 25°32′ S, 50°19′ W, 20 November 1993, Eliasaro 1104 (UPCB 24818); Jaguariaíva, Parque Estadual do Cerrado, 25°32′ S, 50°19′W, 16 April 1994, *Eliasaro 1263, 1274* (UPCB 24823, 24821).

Remarks: *H. silvatica*, a Brazilian endemic, formerly recorded only for the States of Mato Grosso and Pará, is here reported for the first time for the State of Paraná, extending its distribution to the SE.

Relicina abtrusa (Vain.) Hale, Phytologia **28**: 484. 1974.

Thallus saxicolous or corticolous, yellowish-green, adnate, 4-10 cm across. Lobes with truncate apices and ciliate margins, up to 2 mm wide, cilia bulbate, 0.1-0.5 mm long. Upper surface plane, sparse to densely isidiate, isidia erect, simple or branched, commonly with brown apices, isolated or in groups. Medulla white. Lower surface black,

brown and papillate in a zone bellow the apices or black to the margin, rhizines black, simple. Apothecia sessile, coronate, thalline exciple isidiate or not, disc brown; ascospores 4.5-6 x 6.5-7.5 μm. Pycnidia laminal, immersed, conidia not seen.
Chemistry: Upper cortex K- or K+ yellow (usnic acid, major; atranorin ±; lichexanthone ±). Medulla K+ yellow turning red (norstictic acid, major).

Selected specimens examined: **Paraná**. Tibagi, Canion Guartelá, 25° 32′ S, 50° 19′W, saxicolous, 17 April 1994, *Eliasaro 1309* (UPCB 24815), corticolous, *Eliasaro 1319* (UPCB 24819); Curitiba, Parque Barigui, 25°26′ S, 49°18′ W, 800 m.s.m, corticolous, 29 August 1994, *C. Morales 56* (UPCB 24825). **Tocantins**. Lizarda, Fazenda Morro Redondo, 09°34′ S, 46°43′ W, corticolous, 19 August 1992, *Eliasaro 922* (UPCB 22125).

Remarks: *R. abtrusa*, "a very common species in both the New World and the Old World" (Hale, 1975), was formerly recorded for the Brazilian States of Mato Grosso, Mato Grosso do Sul, Minas Gerais, Rio de Janeiro, São Paulo, Bahia, Goiás and Pará. These are the first reports for Paraná and Tocantins.

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REFERENCES

Elix, J. A. (1994). *Parmotrema, Flora of Australia* **55**: 140-163. CSIRO. Australia.

Elix, J. A., Johnston, J. & Parker, J. L. (1987). A Computer Program for the Rapid identification of lichen products. *Mycotaxon* **31**: 89-99.

Hale, M. E. (1974). Notes on species of *Parmotrema* (Lichenes: Parmeliaceae) containing yellow pigments. *Mycotaxon* **1**: 105-116.

Hale, M. E. (1975). A monograph of the lichen genus *Relicina* (Parmeliaceae). *Smithsonian Contrib. Bot.* **26**: 1- 32.

Hale, M. E. (1976). A monograph of the lichen genus *Bulbothrix* Hale (Parmeliaceae). *Smithsonian Contrib. Bot.* **32**: 1-29.

Hale, M. E. & Fletcher, A.. (1990). *Rimelia* Hale & Fletcher, a new lichen genus (Ascomycotina: Parmeliaceae). *Bryologist* **93**: 23-29.

Holmgren, P. K., Holmgren, N. H. & Barnett, L. C. (1990). Index Herbariorum. 8th de. Part Y.: The herbaria of the world. *Regnum Veg.* **120**: 1-693.

Krog, H. (1974). *Parmelia ultralucens*, a new lichen species in subgenus *Amphigymnia*. *Bryologist* **77**: 253-256.

Krog, H. & Swinscow, T. D. V. (1981). *Parmelia* subgenus *Amphigymnia* (lichens) in East Africa. *Bull. Brit. Mus. Nat. Hist. (Bot.)* **9**: 143-231.

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POLYMORPHISM OF VEGETATIVE PROPAGULES IN *PUNCTELIA PUNCTILLA* (PARMELIACEAE, LECANORALES) AND THE DELIMITATION OF THE SPECIES

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ABSTRACT: The ontogeny and polymorphism of the vegetative propagules of *Punctelia punctilla* (Hale) Krog, which have previously been misinterpreted, are described with detail. A similar propagule polymorphism was observed in specimens which fit in the diagnosis of *P. missouriensis* G. Wilh. & Ladd. Consequently, a wide concept of *P. punctilla* is proposed, considering the name *P. missouriensis* as a synonym, and its distribution is extended.

Introduction

When Krog (1982) segregated the new genus *Punctelia* characterized by the pseudocyphellae in the upper surface, she placed *P. punctilla* in subgenus *Punctelia*, mainly because of the presence of atranorin in the upper cortex and the unciform conidia. Hale (in Krog & Swinscow, 1977) had previously described *P. punctilla* as a saxicolous, isidiate species, with a pale brown lower surface and medullary lecanoric acid. Some of the principal types of propagules present and their ontogeny, were well interpreted in the latin diagnosis: "...cortex..., lobulato-isidiatus, isidiis primo papilliformibus, deinde cylindricis, postremo parum expansis, decumbentibus, dorsiventralisque, aetate densis". Thus, papilliform, cylindrical and dorsiventral isidia (phyllidia sensu Hawksworth, 1984) as well as lobules, were recognized as the main types of propagules, but neither soredia nor sorediate phyllidia were mentioned.

The isidia of *P. punctilla* were later described, as follows: 1) "isidia low, papilliform or sparingly branched, with a dull surface" (Krog, 1982), 2) "isidia laminal, crowded, at first papilliform, becoming cylindrical, simple or sparingly branched, rarely flattened, with a poorly developed cortical layer and a matt appearance" (Swinscow & Krog, 1988), 3) "isidia low, papilliform or sparingly branched with a dull surface" (Riefner, 1989), and 4) "isidia... cylindrical to somewhat flattened, darkly apiculate and frequently coralloid-branched" (Wilhelm & Ladd, 1992). All of these authors considered *P. punctilla* to be a saxicolous species.

On the other hand, *P. missouriensis* (also with pale brown lower surface and medulla containing lecanoric acid) was described by Wilhelm & Ladd (1992) as a corticolous species whose propagules were interpreted as coarse soredia, granular to often lobuliform, sometimes partly corticate and occurring in small clusters of 10 or fewer per soralium. These authors consider that *P. punctilla*, is "coarsely isidiate..., superficially similar to *P. missouriensis*", but lacking the "well-defined soredia" and the "flattened, sorediose lobules" of *P. missouriensis*.

The present work has established that the propagules of *P. punctilla* and *P. missouriensis* really display analogous polymorphism and that the perceived differences are not significant at the species level.

Material and Methods

This work is based on an examination of saxicolous and corticolous specimens of *Punctelia* with pale lower surface, a white medulla containing lecanoric acid, a grey pseudochyphellate upper cortex containing atranorin and forming secondary propagules, either polymorphic isidia or soredia as the predominant types. In the first group (*P. punctilla* plus *P. missouriensis*), only 22 % of the corticolous and 68 % of the saxicolous specimens cited had pycnidia, whereas 4 % of the former and 24 % of the latter had apothecia. In the second group (*P. subrudecta*), only the pycnidiate specimens (mostly corticolous) are cited.

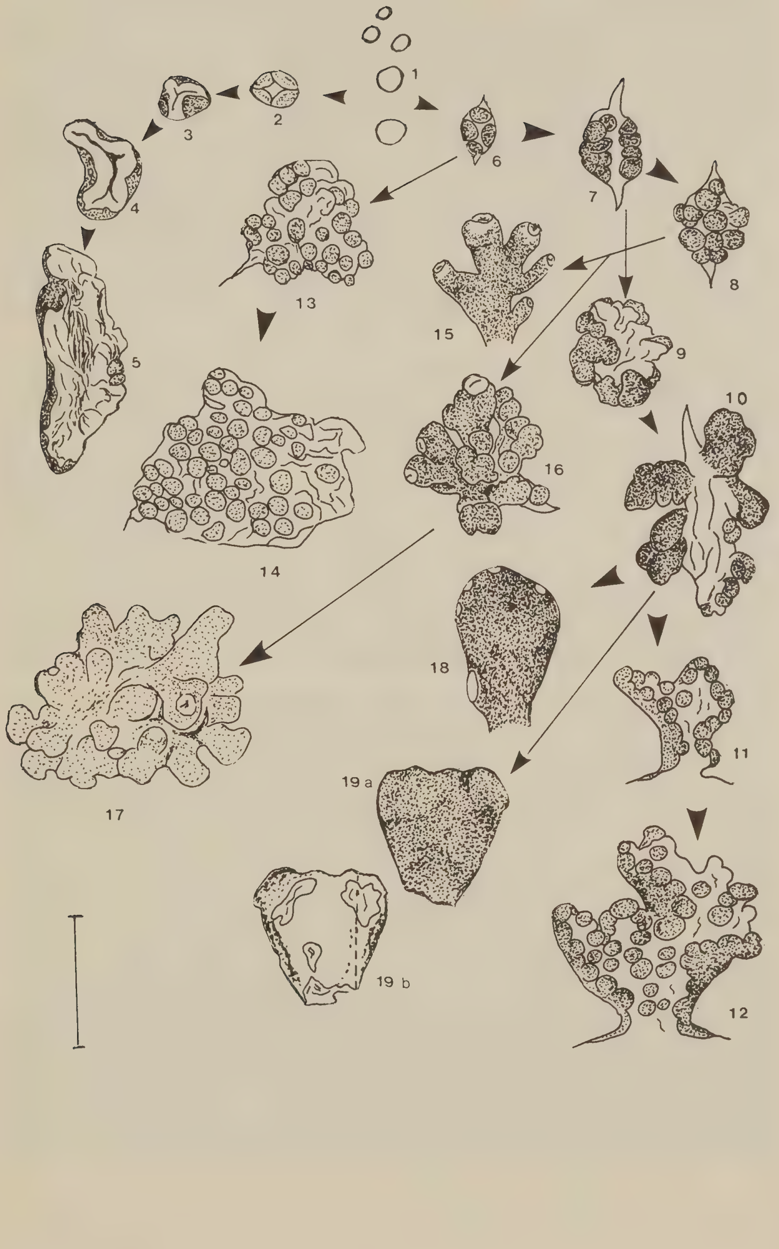
The collections studied are housed at ASU, BAFC, BM, CANB, GB, H, LD, MOR, S and US. The abbreviated herbarium names follow Holmgren et al. (1990). The identification of lichen substances was achieved by means of thin layer chromatography (Culberson & Ammann, 1979), using authentic samples for comparison.

For routine observations with the light microscope, thallus sections were cut with a razor blade, softened in 5 % KOH and stained with 1 % phloxin, or alternatively, the KOH was washed away and staining was achieved with cotton blue in lactophenol. Permanent thin sections (5 µm thick) for photomicrographs, were prepared as described for transmission electron microscopy (D'Ambrogio de Argüeso, 1986) but mounted on slides and stained for light microscopy. Scanning electron microscopy was performed with a Joel SEM JSM-T 100 microscope where air dried samples were covered with gold.

Results and discussion

It was possible to distinguish two major groups within the collections: those with secondary soralia developing only farinose to granular soredia (corresponding to *P. sub-*

Fig. 1. Polymorphism of the vegetative propagules in *Punctelia punctilla* (including *P. missouriensis*): ontogenetic relation of the different forms. Comments and interpretation in the text. Scale= 0.5 mm.


19 a
19 b

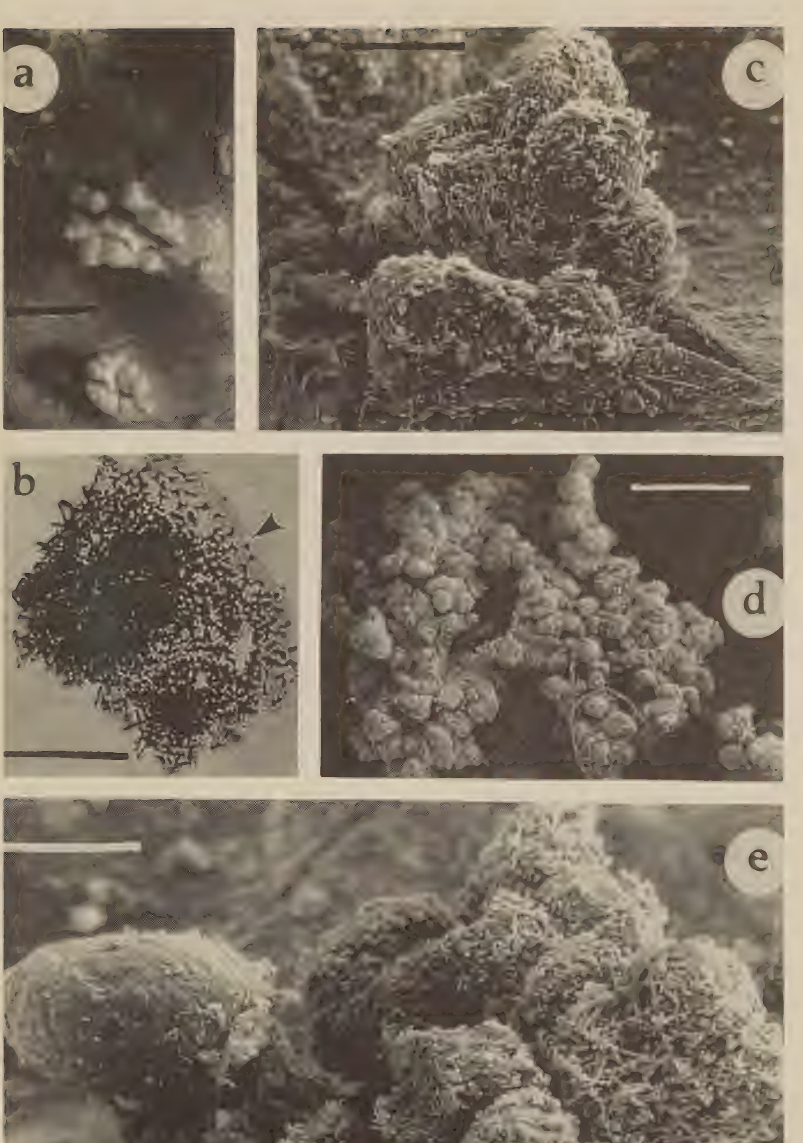
rudecta) and those showing a much greater variation in form and structure of the propagules, representing *P. punctilla* (including *P. missouriensis*). The various types of propagules in this second group and their ontogeny, are illustrated schematically in Fig. 1. The progression from 1 to 5 shows the pseudocyphellae enlarging without development of propagules. The large pseudocyphellae with a white rim (Fig. 1- 4 and 5), are present in many saxicolous specimens and have been mentioned by Hale (in Krog & Swinscow, 1977) and Krog (1982), but are infrequent in the corticolous specimens studied. A feature common to both saxicolous and corticolous specimens, is the presence of cracks, spreading out from many pseudocyphellae (Fig. 1- 6, 7, 8 and 10), as described previously by Wilhelm & Ladd (1992) for *P. missouriensis*. Fig. 1- 6 and 7 also illustrate young primordia of propagules; the stage represented in Fig. 1- 7 is shown in the photograph (Fig. 2a) taken of a corticolous Argentine specimen. A longitudinal section of one of these large soredia or primordia (Fig. 2b) shows that they are frequently slightly dorsiventral, stiff and enclosed within a gelatinous envelope. Fig. 2c shows a cracked pseudocyphella with smaller (younger) "well-defined soredia" in a saxicolous specimen.

Small masses of soredia (Fig. 2e and in section, Fig. 3a) are frequently present on saxicolous specimens; they may eventually become larger by coalescence (Fig. 1- 13, 14 and Fig. 2d). Soredia masses are frequently observed on the same thallus where "papilliform isidia", phyllidia and lobules are present. For example, Fig. 2e shows a "papilliform isidium" growing out adjacent to a small mass of soredia.

According to Wilhelm & Ladd (1992): "the cortical pseudocyphellae of *P. punctilla*, although sometimes appearing incipiently erumpent, do not develop into aggregated groups of well-defined soredia"; nevertheless they have been observed in the corticolous (Fig. 2a, b) as well as in the saxicolous specimens (e.g. Fig. 2c). The larger "well-defined soredia" function as primordia of cylindroid isidia (Fig 1- 15, 16 and 17), phyllidia (Fig. 1- 9, 10, 11 and 12) and lobules (Fig. 1- 18 and 19).

The more or less cylindrical propagules (cylindroid isidia), frequently have pseudocyphellae at the tips (Fig. 1- 15 and 16); these are the "cylindrical isidia" of *P. punctilla* sensu Hale and other authors. The early stage of their development (here interpreted as "papilliform isidia") is represented in surface view in Fig. 1- 8 and in longitudinal section, in Fig. 3b. These papilliform isidia lack cortical tissue. In advanced stages they may branch (Fig. 1- 15 and 16) and frequently become deformed (Fig. 1- 17). Hale (in Krog & Swinscow, 1977) originally described the main types of propagules of *P. punctilla* as "isidia... at first papilliform, becoming cylindrical, simple or sparsely branched, rarely flattened, with a poorly developed cortical layer and a matt appearance".

Fig. 2. Propagule primordia and soredia in Argentine specimens of *Punctelia punctilla*. a) Cracked pseudocyphella with propagule primordia or "well-defined soredia" (arrow) in a corticolous specimen (BAFC 37140); scale = 0.25 mm. b) Section of the primordium shown in a) with gelatinous covering (arrow); scale = 200 µm. c) Young cracked pseudocyphella with small "well defined soredia" (SEM) in a saxicolous specimen (BAFC 35681); scale = 100 µm. d) Large mass of soredia (SEM) in a saxicolous specimen (BAFC 36082); scale = 0.4 mm. e) Part of an old pseudocyphella with a small mass of soredia (right) and a papilliform isidium (left), (SEM), in a saxicolous specimen (BAFC 35681); scale = 100 µm.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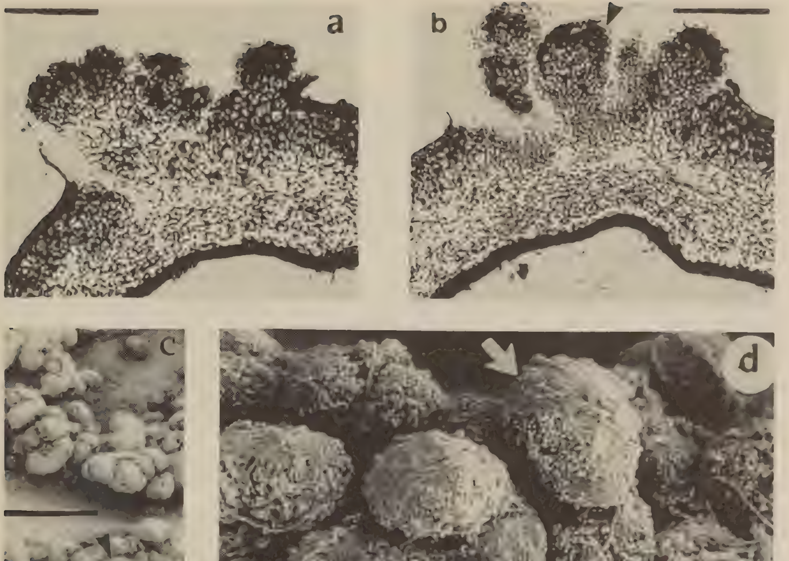
However, the present study shows that whereas the “papilliform isidia” are very frequent, true cylindrical isidia are almost absent and that phyllidia, masses of coalescent soredia and lobules are common. The phyllidia are only corticated dorsally, whereas the lobules have dorsal and ventral cortical tissue and frequently small marginal (Fig. 1- 18) or ventral pseudocypellae (Fig 1- 19b). The cortex of the cylindroid isidia and phyllidia may frequently be poorly developed, as observed by Hale (in Krog & Swinscow, 1977) and other authors. The young phyllidia as shown in Fig. 3c and 3d, can also be interpreted as "papilliform isidia". A longitudinal section of one such propagules (Fig. 3e) shows that they are dorsiventral, ecorticate, but sorrounded by a gelatinous covering. A cortical tissue may later develop (Fig. 3f).

In the specimens with propagule polymorphism, it was observed that: 1) the mature esorediate phyllidia of corticolous North American specimens (Fig. 4a) were identical to mature phyllidia of saxicolous Argentine collections (Fig. 4d) both showing similar stages of development (e.g. Fig 3b, c and d) and 2) the main types of propagules in corticolous collections from both South and North America were identical, although present in variable proportion depending on the particular specimen.

Only minor, taxonomically insignificant differences, have been observed between the corticolous and the saxicolous specimens: 1) thallus and propagules are rarely brown-tinged in the former, whereas they are usually brownish-grey in the latter (a consequence of exposure to light) and 2) large, white-rimmed pseudocyphellae (Fig.1- 4 and 5) are infrequent in the corticolous specimens, but are common in the saxicolous collections. These white-rimmed pseudocyphellae may become quite large without forming propagules; these could be a result of periods of thallus growth under conditions of low water content (frequent on rocks), which could hinder algal division and propagule development, during the expansion of the pseudocyphellae. Although Krog (1982) used this feature as a key character for *P. punctilla*, the present observations indicate that the white rim is actually an ecological modification of the pseudocyphellae. Consequently, it does not constitute a consistent, morphological character for the distinction of *P. punctilla*.

It has also been observed that mature phyllidia (branched or not) may develop marginal or both marginal and ventral soredia (Fig. 1- 11, 12 and Fig. 5) in corticolous as well as in saxicolous specimens. These sorediate phyllidia have been called "sorediose lobules" by Wilhelm & Ladd (1992), who describe them as "infrequently simple branched" and as "sometimes occurring in *P. missouriensis*". A SEM photograph of two unbranched sorediate phyllidia in a corticolous Argentine specimen, is shown in Fig. 5a. Sections of such dorsally corticated phyllidia from a saxicolous Argentine specimen, are

Fig. 3. Propagules of *Punctelia punctilla* in a saxicolous specimen (BAFC 35681). a) Section of a sorediate pseudocyphella ; scale = 50 µm. b) Section of pseudocyphella with papilliform isidia; scale = 50 µm. c) Young phyllidia (SEM) as indicated by the arrow; scale = 0.4 mm. d) Detail of c); scale = 100 µm. e) A longitudinal section of a young phyllidium as shown in d) with thin gelatinous covering (arrow); pf = point of fixation); scale = 200 µm. f) Section of propagules (SEM): young primordium (white arrow), young phyllidium (black arrow, left) and mature corticate phyllidum (black arrow, right); scale = 80 µm.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shown in Fig. 5b, c and d. Sorediate phyllidia have not been described before for *P. punctilla*, but are actually common in many saxicolous Argentine specimens, and were observed in the holotype and other African collections cited by Hale (in Krog & Swinscow, 1977). The presence of such in both *P. missouriensis* and *P. punctilla*, supports the synonymy of these entities.

As the diagnosis of *P. missouriensis* did not include the type of conidia present (Wilhelm & Ladd, 1992), their precise characterization remained undetermined. Nevertheless, approximately a 30% of the corticolous Argentine specimens studied, have pycnidia with unciform to straight conidia, and in all other features are identical to the corticolous North American exemplares examined. This supports the assumption made by Wilhelm & Ladd (1992) that *P. missouriensis* had unciform conidia and reinforces the view that this species is the corticolous form of *P. punctilla*. *P. subrudecta* is considered to be a species closely related to *P. punctilla*, as both species have unciform conidia mixed with a variable proportion of straight ones (Fig. 6). The conidia were found to be, (4-) 5-7 (-8) µm long in *P. punctilla* and (3.5-) 4-6 (-6.5) µm in *P. subrudecta*. These two species differ only in the type of vegetative propagules produced, namely polymorphic propagules in the former and farinose to granular soredia in the latter.

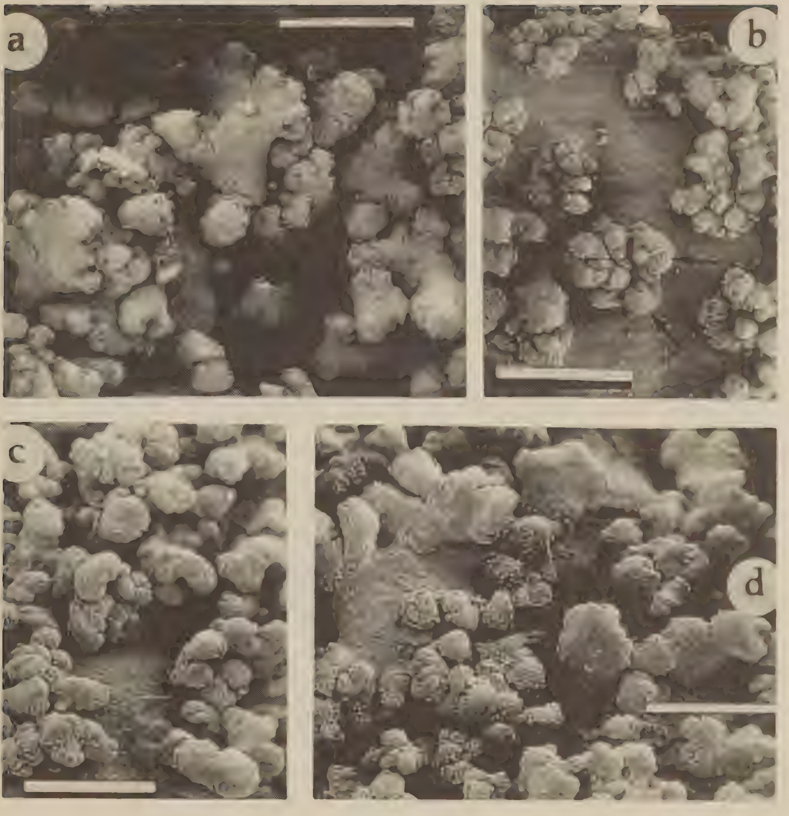
Conclusion

The above reinterpretation of the propagules present in *P. punctilla* leads to a broad concept for this species, as detailed in the following description.

Punctelia punctilla (Hale) Krog

Nord. J. Bot. **2**: 291 (1982).- *Parmelia punctilla* Hale, in Krog & Swinscow, *Norw. J. Bot.* **24**: 172 (1977). [Typus: South Africa, Distr. Bergville, Cathedral Peak Area, 5,500 m, Indumeni Forest, on rock, Almborn 8941, 3 November 1953 (LD-holotype!; US-isotype, not seen)].- *Punctelia missouriensis* Wilhelm & Ladd, *Mycotaxon* **44**: 495 (1992). [Typus: USA, Crawford County, Onondaga Cave State Park, on *Juniperus virginiana*, Ladd & Wilhelm 15879, 22 December 1991 (MOR- holotype; COLO, F, IMI, LSU, MICH, NY, O, OMA-isotypes not seen; BAFC 37223, US-isotypes!].

Fig. 4. a) Isotype of *Punctelia missouriensis* (BAFC) showing the well developed phyllidia (SEM) in the central parts of the thallus; scale = 0.5 mm. b), c) d) A saxicolous specimen of *Punctelia punctilla* (BAFC 35680) (SEM): b) Young phyllidia (black arrows) and soredia (white arrow) in young parts of the thallus, c) and d) Mature, dorsally corticate phyllidia, in the central parts of the thallus; scale = 0.5 mm.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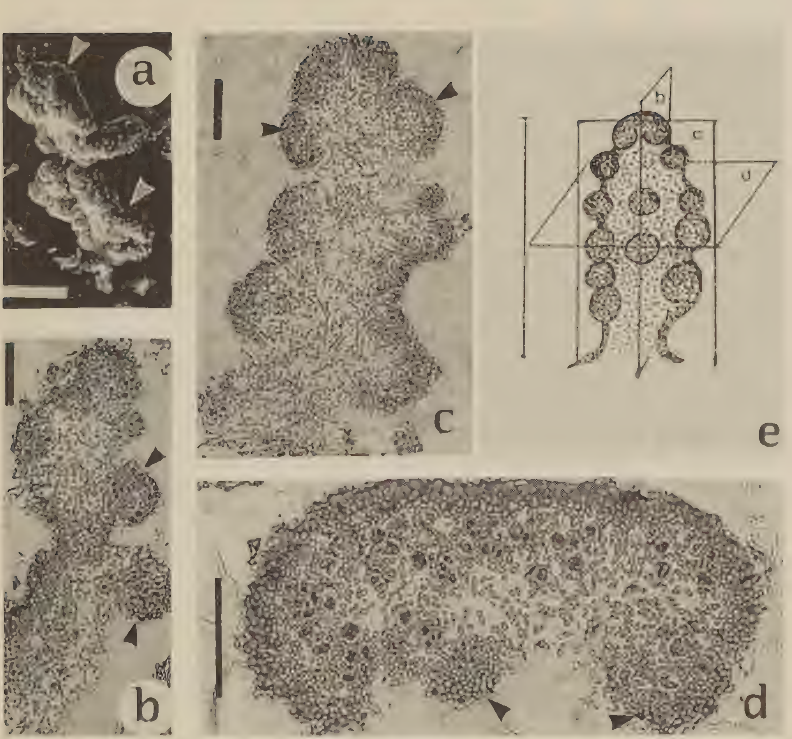
Thallus foliose, up to 15 cm diam., corticolous, saxicolous, or growing over saxicolous mosses, brownish or greenish-grey, closely attached to the substrate. *Lobes* subirregular, frequently apically rounded, crenate to incised, 2-7 mm broad. *Upper surface* and margins pseudocyphellate, pseudocyphellae punctiform, at first 0.05-0.2 mm diam., not marginate, at maturity 0.5-0.8 mm diam., often with a white rim in saxicolous specimens. *Propagules* developing inside the pseudocyphellae, polymorphic: including soredia; papilliform isidia; cylindroid ± commonly branched isidia; ± sorediate, ± branched phyllidia, and lobules; cortical tissue frequently poorly developed in cylindroid isidia. *Medulla* white. *Lower surface* pale brown to yellowish-white, usually darker at the lobe apices, rhizines concolorous, simple or irregularly branched. Apothecia shortly stipitate, disc brown, imperforate, up to 0.8 mm diam., amphithecium pseudocyphellate, sometimes with secondary propagules; asci 8-spored, ascospores (6-) 7-10 (-13) x (8-) 10-14 (-16) µm. Pycnidia laminal, immersed, grouped submarginally on the lobes. Conidia unciform to straight, (4-) 5-7 (-8) µm long.
Chemistry: upper cortex K+ yellow (atranorin); medulla K-, C+ red to pink, KC+ red, containing lecanoric acid (major) and one to three unidentified depsides (minor/trace).

Remarks: *Punctelia punctilla* and *P. subrudecta* are closely related species with most taxonomicaly important characters in common. They differ consistently only in the type of propagules developing from the pseudocyphellae. As correctly stated by Wilhelm & Ladd (1992): "*P. subrudecta* has farinose to finely granular soredia occurring in large numbers in each soralium". However the present study established that phyllidia and lobules are occasionally formed in *P. subrudecta*, but very rarely. On the other hand, *P. punctilla* shows propagule polymorphism where phyllidia (either sorediate or not) are very frequent.

Distribution: *Punctelia punctilla* was first described from South Africa (Hale in Krog & Swinscow, 1977). Later this species was recorded from South America (Argentina, Mendoza Province) by Ferraro (1986) and Osorio (1987) (from Buenos Aires Province). Its distribution is here extended within Argentina, to the Provinces of Santiago del Estero (growing on trees and bushes), Corrientes (corticolous), Córdoba (corticolous and saxicolous), and Río Negro (corticolous). Saxicolous colonies of this species are very common on rocks in Córdoba and Buenos Aires Provinces. It is also recorded here for the first time from Venezuela (corticolous).

Riefner (1989) cited this species from California, the first North American collections recorded as growing on rocks. The present work extends this distribution within the USA to ten States, where *P. missouriensis* was cited as being common on trees (Wilhem & Ladd, 1992). Further studies are required to clarify the total range of *P. punctilla*.

Fig. 5. Sorediate phyllidia in *Punctelia punctilla*. a) Marginally sorediate phyllidia (SEM) in a corticolous specimen (BAFC 37139); scale = 0.25 mm. e) Sorediate phyllidium (schematic), showing the section planes of b, c and d ; scale = 0.5 mm. b) Longitudinal section of a phyllidium in a saxicolous specimen (BAFC 37243) with ventral soredia (arrows); scale = 100 µm. c) Tangential section; scale = 100 µm. d) Transverse section, with ventral and marginal soredia (arrows); scale = 50 µm.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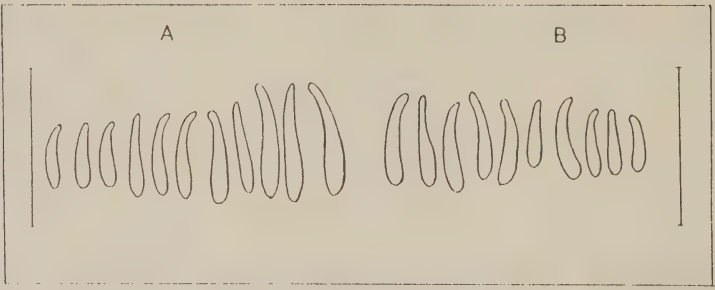

Fig. 6. Conidia in *Punctelia punctilla* (A) and *P. subrudecta* (B). Scale = 10 µm.

Specimens examined:

***Punctelia punctilla*.** **NORTH AMERICA. USA**: Illinois, Saline County, on *Juniperus virginiana*, Wilhelm & Johnson, 22.IX.1988, (BAFC 37237, dupl. of MOR #16619; BAFC 37239, 37241, dupl. of MOR #16553), on *Carya tomentosa* (BAFC 37225, dupl. of MOR #16566); Missouri, Crawford County, Onondaga Cave State Park, Ladd & Wilhelm, 22.XII.1991 (BAFC 37223, US, isotypes of *Punctelia missourensis*); Reynolds County, on *Juniperus virginiana*, Wilhelm, 31.VIII.1982 (BAFC 37224, dupl. of MOR #10533).- **AFRICA. Basutoland**: Div. Leribe, Gorge, Kofler, 1.XII.1963 (LD), Oxbow, 2700 m, Kofler, 30.XI.1963 (LD), Buthabuthe, Kofler 3 12 18 23, 1.XII.1963 (LD), Mt. Moshoeshoe, Kofler 23.III.1963 (LD); Div. Maseru, bank of the Makhaleng River, Kofler, 31.V.1962 (LD), Roma Valley, Kofler, 24.VI.1962 (LD), S side of Roma Valley, Kofler, 1.VII.1962 (LD).- **South Africa**: Orange Free State, Div. Ladybrandt, on sandstone, 1500-1800 m, Maas Gesteranus 6547, 18.XI.1949 (LD); Cape Prov., Distr. Madadiele Porter's Hook., boulders at the waterfall, Höeg, 14.10.1929 (LD); Distr. Dardricht, Höeg, 21.11.1929, (LD); Div. Elliot, Höeg, 1.XII.1929 (LD); Natal, Distr. Vryheid, 5 miles N of Vr., on steep rock N. of road, Almborn 8027, 24.X.1953 (LD); Distr. Bergville, Cathedral Peak Area, 5500 m, Indumeni Forest O. Almborn 8911, 3.XI.1953 (LD-Holotype). - **SOUTH AMERICA. Venezuela**: Mérida, entre San Juan de Lagunilla y Las Gonzales, 900 m, corticolous, mixed with *P. perreticulata*, Hale 42341A, 24.I.1974 (US). **Argentina**: Santiago del Estero Prov., Departamento de El Copo, Pirpintos, on *Schinopsis lorentzii*, J. Protomastro, II.1985 (BAFC 37152, 37153, 37339, MOR), corticolous, J. Protomastro, IV.1985 (BAFC 37133, 37136), Reserva de El Copo, corticolous, J. Protomastro, II.1985 (BAFC 37134), J. Protomastro, VI.1985 (BAFC 37135), J. Protomastro, II.1986 (BAFC 37132, 37137, 37138, MOR), on *Acacia praecox*, J. Protomastro, II.1986 (BAFC 37139, 37140, MOR); Corrientes Prov., Departamento Capital, San Cayetano, corticolous, L. Ferraro 3110, 18.III.1985 (H); Córdoba Prov., 9 Km from Tanti on route 28, on rock, Adler, X.1985 (BAFC 37194, 37195), 1 Km from El Observatorio Adler, X.1985 (BAFC 37143); Cerro Colorado, corticolous in bosque serrano, C. Estrabou (BAFC 37248a), saxicolous in bosque serrano, C. Estrabou, III.1995 (BAFC 37248a); La Cumbre, Balneario El Chorrito, on rock, N. Scutari, XI.1992 (BAFC 37340, H); Segunda Usina Embalse Cassafourth (32°10'S, 64°23'W), on rock in bosque serrano, N. Vischi, 17.IV.1986 (BAFC 37145, 37146) ; Buenos Aires Prov., Partido de San Vicente, Domselaar, Arroyo Manantial, on

Salix sp., Adler & J. Protomastro, 29.VI.85 (BAFC 37198); Partido de Balcarce, Balcarce, INTA, on rock, Adler III.1988 (BAFC 37166), Partido de Olavarría, Olavarría, Sierra La China, on rock, Adler, III.1986 (BAFC 35683, 35684, 37161, 37162, 37164); Partido de Tandil, Tandil, La Movediza, on granitic rock, Adler, I.1987 (BAFC 35920, 37163), Parque Independencia, on rock, Adler, XI.1989 (BAFC 37149, H; BAFC 37157), Sierra del Tigre, Adler, XI.1989 (BAFC 37150); Partido de Tornquist, Abra del Pantanoso Viejo, on route 76, on rock, Adler & Bertoni, X.1992 (BAFC 37266, H; BAFC 37277, 37278, H; BAFC 37279, 37280, 37281, 37330, 37332), Abra de la Ventana, at the base of Cerro Bahía Blanca, on route 76, Adler & Bertoni, X.1992 (BAFC 37246, 37253, 37265, S; BAFC 37270, 37271, 37272, GB), Arroyo La Blanqueada, N. Scutari, IX.1989 (BAFC 37154), Arroyo Los Helechos, Adler, V.1986 (BAFC 35680, 35681, 35798, 37147, 37151, 37158, 37165); Cerro del Amor, on rock or saxicolous mosses, Adler & Bertoni, X.1992 (BAFC 37273, CANB; BAFC 37274, ASU; BAFC 37275; 37276; 37333, 2 dupl. LD, MOR; BAFC 37335), El Pinar, on rock, Adler & Bertoni, X.1992 (BAFC 37242, 37243, CANB; BAFC 37244, 37245, 37267, 37268, MOR; BAFC 37269, S), El Portillo, on rock, N. Scutari, IX.1989 (BAFC 37159, ASU), Parque Forestal Provincial, on rock or saxicolous mosses, Adler, V.1986 (BAFC 35677, 35678, CANB; BAFC 37144; 37148; 37156; 37160), G. Vobis, V.1986 (BAFC 35679; 35682; 36081; 36082); Río Negro Prov., Nahuel Huapi National Park, Cerro Tronador, on *Nothofagus pumilio*, P. Ranta 2023, 29.X.1983 (H).

Punctelia subrudecta: **EUROPE**.- **Poland**. Tobolewski: Lichenoth. Pol. 220 (US).- **Hungary**: Bükk Mts., VIII.1967, Fóriss (GB 98114); Stomfa, Pozsony, VI.1914 Zahlbruckner & Timkó (GB 98126).- **Montenegro**: VI.1971, Vitikainen 7280 (H).- **Slovenia**: Volcji Potok, VI.1978, Issakainen (H).- **Germany**: Baden, IX.1893, Duh (GB 98120).- **Italy**: Liguria: Spotorno, IX.1935, Sbarbaro (US).- **Canary Islands**: Gran Canaria, IV.1975, Krog & Østhagen 832 (S).- **AUSTRALASIA. New Zealand**: North Island, Wellington, V.1962, Wade 57 (BM).- **ASIA. India**: Tamil, 1973, Hale 40164 (US).- **Indian Ocean**: Iles St-Paul, 1874-75, G. de l'Isle (H-NYL 35033, lectotype of *Parmelia subrudecta* Nyl., by Hale 1965).-

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References

Culberson, C.F. & Ammann, K.. (1979). Standardmethode zur Dünnschicht-chromatographie von Flechtensubstanzen. *Herzogia* 5: 1-24.

D'Ambrogio de Argüeso, A.(1986). *Manual de técnicas de histología vegetal*. Ed. Hemisferio Sur S.A. 1a Edición.

Ferraro, L. I. (1986). Contribution to the study of Argentine Parmeliaceae. The genus *Punctelia* Krog and *Flavopunctelia* (Krog) Hale. *Phytologia* 61: 189-203. 2 pl. Oregon.

Ferraro, L. I. (1986). Contribution to the study of Argentine Parmeliaceae. The genus *Punctelia* Krog and *Flavopunctelia* (Krog) Hale. *Phytologia* 61: 189-203. 2 pl. Oregon.

Hawksworth, D.L. & Hill, D.J. (1984). *The lichen-forming fungi*. Blackie, Glasgow and London. 158 pp.

Holmgren, P. K., Holmgren, N.H. & Barnett L.C.(1990). Index Herbariorum. 8th ed. Part I.: The herbaria of the world. *Regnum Veg.* **120**: 1-693.

Krog, H. (1982). *Punctelia*, a new lichen genus in the Parmeliaceae. *Nord. J. Bot.* **2**: 287-292.

Krog, H. & Swinscow, T. D. V. (1977). The *Parmelia borreri* group in East Africa. *Norw. J. Bot.* **24**: 167-177.

Osorio, H.S. (1987). Contribution to the lichen flora of Argentina. XVI. Lichens from Sierra de La Ventana, Buenos Aires Province. *Comun. Bot. Mus. Hist. Nat. Montevideo*. **4**(78): 1-11.

Riefner, R. E., Jr. (1989). *Punctelia punctilla* (Hale) Krog, new to North America. *Phytologia* **67**: 254-257.

Wilhelm, G. & D. Ladd (1992). A new species of the lichen genus *Punctelia* from the Midwestern United States. *Mycotaxon* **44**: 495-504.

Swinscow, T. D. V. & Krog, H. (1988). *Macrolichens of East Africa*. 390 pp. Brit. Mus. (Nat. Hist.). 1st ed.

MYCOTAXON

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A NEW CONTRIBUTION TO THE KNOWLEDGE OF THE GENUS *AGARICUS* IN CHILE. *AGARICUS WRIGHTII* SP.NOV.

by

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Summary: Seven taxa of ***Agaricus*** (***Agaricaceae***) collected in ***Nothofagus sps.*** and ***Pinus radiata*** forests, lawns and grasslands of Valdivia (south of Chile) and its surroundings are reported and/or commented upon. Macrophotographs of the morphological characters of some of them are added. ***Agaricus wrightii*** is proposed as a new species and ***Agaricus crocodilinus*** constitutes a new record for the Chilean mycological catalogue and, according to our data, also for South America.

Key words: *Agaricus wrightii, Agaricus, Agaricaceae, Agaricales, Nothofagus, Pinus,* Chile, taxonomy.

INTRODUCTION

Fifteen species and one variety of ***Agaricus*** L.:Fr. have been reported from different areas of Chile up to now. This is a low number considering the wide ecological diversity of this country, which ranges from deserts in the north to deciduous temperate or subantarctic forests in Patagonia and Tierra del Fuego.

Taking into account the previous contributions of Garrido (1985, 1988), Heinemann (1986, 1990) and Valenzuela et al. (1992), the following list of taxa gathers all the known records of ***Agaricus*** up to date in Chile.

I. Native *Agaricus*: ***Agaricus curanilahuensis*** Garrido, ***A. nebularum*** Sing., ***A. phaeocyclus*** var. ***pucutrihuensis*** Heinemann and ***A. valdiviae*** Sing.

II. Exotic *Agaricus*: ***Agaricus arvensis*** Schaeff., ***A. augustus*** Fr., ***A. bernardii*** (Quél.) Sacc., ***A. bisporus*** (J.E.Lange) Imbach, ***A. bitorquis*** (Quél.) Sacc., ***A. campestris*** L.: Fr., ***A. mediofuscus*** (Möll.) Pilát., ***A. placomyces*** Peck, ***A. porphyrizon*** P. D. Orton, ***A. urinascens*** (Möll. & J.Schaeff.) Heykoop [***A. albertii*** M.Bon/= ***A. macrosporus*** (Möll. & J.Schaeff.) Pilát, non Mont.], ***A. xanthoderma*** Genev. and ***A. xantholepis*** (Möll.) Möll.

In this contribution, seven ***Agaricus*** taxa from Valdivia (south of Chile) and its surroundings are reported, of which ***Agaricus wrightii*** is proposed as a new species and ***Agaricus crocodilinus*** is recorded for the first time in Chile.

MATERIAL AND METHODS

The material was collected in ***Nothofagus sps.*** and ***Pinus radiata*** forets, lawns and grasslands. Microscopic sections of all the specimens were mounted in KOH 5% and water; for the spore measurements of the new species, we have followed the method proposed by Heinemann & Rammeloo (1985). The material has been deposited in AH (Herbarium of Alcalá de Henares University, Madrid, Spain).

LIST OF TAXA

Agaricus arvensis Schaeff.
Jardín Botánico Universidad Austral de Chile, Valdivia, in lawns, 20-IV-1992 (*leg.* J. Grinbergs), AH 15254.

Agaricus campestris L.: Fr.
Pichoy, Valdivia, in pastures, 25-III-1990 (*leg.* J. Grinbergs & S. Garnica), AH 15255.

Agaricus crocodilinus Murr. (Fig. 1)
Popoén, San Juan de la Costa, Osorno, on soil under ***Pinus radiata***, 6-I-1992 (*leg.* S. Garnica), AH 15256.

Our material agrees rather well with Murrill's description (1912); we have observed the following characters in our specimens: pilei 5-20 cm in diam., when young white to pale yellow, glabrous, later ornamented with large warts or thick scales disposed radially and more densely at the center; stipe 5-12 x 3-5.5 cm, fusiform-ventricose to subbulbous, with remnants of a collapsed white ring, towards the base with 1-2 annuliform bands, firm, white, turning yellow-ochre; smell and taste fungoid; KOH 10% on the pileus and flesh negative, Schaeffer's reaction negative in exsiccata; spores 10-12 (-13) x 6-7 µm, broadly ellipsoid to subamygdaliform, smooth, without germ pore; cheilocystidia 10-25 x 9-12 µm, clavate; pileipellis consisting of cylindrical hyphae 4-6 µm in diam; clamp connections absent.

Agaricus crocodilinus is reported for the first time in South America; in Chile it seems to have been introduced with ***Pinus radiata***. On the other hand, Arora (1986) reports that in the United States (North Carolina and N.W. Pacific) it is very common in pastures and pine groves; it has also been reported from N.E. Mexico and Colorado.

Agaricus urinascens (Möll. & J.Schaeff.) Heykoop
= ***Agaricus albertii*** M.Bon
= ***A. macrosporus*** (Möll. & J.Schaeff.) Pilát
Osorno, in pastures. 19-III-1990 (*leg.* E. Valenzuela), AH 13947. Parcela de R. Salas, Osorno, in lawns under ***Malus spp.*** 1-I-1992 (*leg.* R. Salas & J. Grinbergs), AH 15257. Parcela de R. Salas, Osorno, on soil under ***Pinus radiata***, 22-III-1992 (*leg.* R. Salas), AH 15285.

Agaricus valdiviae Sing. in Sing. & Moser, Mycopathol. Mycol. Appl. XXV(2-3):161 (Fig. 2)
Cruce los Tambores, Puente Río Bueno, Osorno, on soil under ***Peumus boldus*** (boldo), 22-V-1992 (*leg.* E. Valenzuela & C. Ramírez), AH 15259.

Agaricus valdiviae is a typical species of the Valdivia area (South of Chile) but it has only been cited once by Singer (Singer & Moser, 1965) from Chile; on the other hand, Heinemann (1990) reports this species from Argentina (Buenos Aires and La Plata); the same author (1986) states that ***A. valdiviae*** is very close to ***A. cupreobrunneus*** (Möll.) Pilát, ***A. lividonitidus*** (Möll.) Pilát and ***A. porphyrocephalus*** Möll., but differs by its flesh and cuticle neither reddening nor yellowing, and the different spore-size in these three species.

Agaricus wrightii Valenzuela, Heinemann & Esteve-Raventós, *sp. nov.* (Fig. 3 & 4)

Etymology: in dedication to Dr. J. E. Wright, for his contribution to the progress of the Mycology in South America.

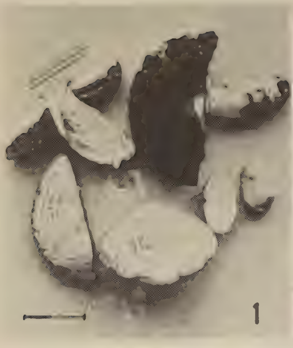
Pileus 6.5-8 cm diam., convexus ad planum-convexum, leucophaeo-argenteus cum pallidis scintillationibus violaceis, tenuiter fibrillosus ad medium cum abundantibus squamis fibrillosis formantibus discum colore castaneo-violaceo pallido. Lamellis liberis, angustis, colore albo ad rosaceum, dein ad leucophaeo-castaneum, devenientes ad brunneus fuscus. Stipe 7.5-11.6 x 0.6-1 cm., leucophaeo-rosaceus, pallidis scintillationibus violaceis, castaneo-rosaceus versus basim, cilindricus, basis leviter ampliata, sed non bulbosa, cum annulo supero. Caro albo-cremeo, in sectura rosaceo pallido, demum castaneo-fusco. Odore saporeque fungico. Sporis 4.4-4.96-5.6 x 3.1-3.54-4.1 µm, late ellipsoideae ad ellipsoideas, castaneo fuscus (in NH_4OH), leves et sine poro germinativo. Basidii 14-16 x 5-7 µm, claviformes, tetrasporii, hialini. Cheilocystidii 11-16 x 4.5-7 µm, claviformes, hialini. Pleurocistidii nulli. Pileipellis formata ex hyphis cylindricis 4.5-9 µm diam., cum pigmento vacuolare et intraparietale brunneus (in KOH 5%). Fibulae nullus.

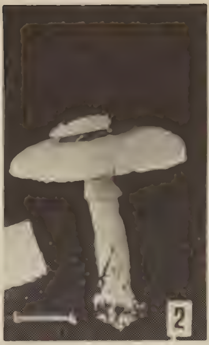
Pileus 6.5-8 cm diam., convex to plano-convex, silvery-greyish with a pale violaceous tinge, covered with very delicate fibrils, towards the center with abundant adpressed fibrillose scales which form a pale brown-violaceus disk. Margin incurved to straight, sometines appendiculate with scarce cream-whitish veil remnants. Gills free, crowded, thin, whitish to pinkish when young, later dark greyish-brown, becoming chocolate-brown when mature, edge entire and concolorous. Stipe 7.5-11.6 x 0.6-1 cm., cylindrical, sometimes slightly clavate or abruptly bulbous, pink-greyish, with a pale violaceous tinge, furfuraceous under the ring, with whitish mycelium at the base. Ring whitish, superior. Flesh thin, cream-whitish, pinkish when cut, later brown. Smell and taste fungoid. In exsiccata pileus dark brown at the center, gills chocolate, stipe base with pinkish tinge; fluorescence absent; An x HNO_3: negative. Spores 4.4-$\underline{4.96}$-5.6 x 3.1-$\underline{3.54}$-4.1 µm, [Q= 1.24-$\underline{1.41}$-1.57 (1,61), n= 40], ellipsoid to broadly ellipsoid, dark-brown in NH_4OH 5%, smooth, without germ pore and thick walls. Basidia 14-16 x 5-7 µm, clavate, 4-spored, hyaline. Cheilocystidia 11-16 x 4.5-7 µ, hyaline, clavate, smooth. Pleurocystidia absent. Pileipellis consisting of cylindrical hyphae 4.5-9 µm diam., forming a cutis, somewhat uplifted in the scales, sometimes loose, with brown incrusting pigment, either in plaques or diminutely "zebra like" in KOH 5%. Clamp connections not observed.

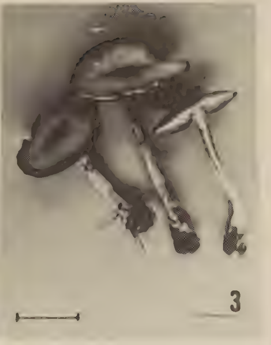
Typus AH 16947, Rebellín, Valdivia, Chile, *leg.* J. Grinbergs, 13-V-1992, on soil in forest of ***Nothofagus obliqua***.

Agaricus wrightii is characterized by the following features: slender habit, pileus silvery-greyish with pale violaceous tinge, delicately smooth-fibrillose at the margin, covered with abundant fibrillose scales towards the center forming a pale brown-violaceous disk; flesh thin, when cut pale pinkish; An x NO_3H negative; spores [Q= 1.24-$\underline{1.41}$-1.57 (1,61), n= 40], and small, clavate cheilocystidia.

These macro and microscopical features place ***Agaricus wrightii*** in the subgenus ***Agaricus*** L.: Fr., section ***Sanguinolenti*** J. Schaeff. & Möll.; one of us (Dr. P.Heinemann) also states that the new species is close to ***A. silvipluvialis*** Pegler (1983), but the latter shows a buffy-brown pileus and longer spores (Q= 1.7); other species such as ***A. diamantanus*** Pegler (1983) is also similar, but it has a dark sienna pileus and shows longer cheilocystidia (24-30 x 5,5-7 µm).







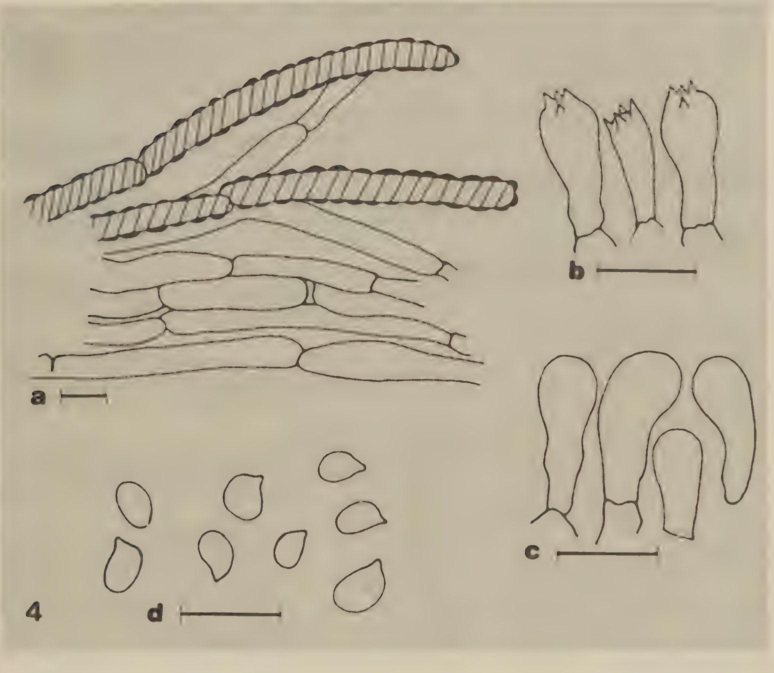


Fig. 1: ***Agaricus crocodilinus*** Murr. (AH 15256), bar = 5 cm;
Fig. 2: ***Agaricus valdiviae*** Sing. (AH 15259), bar = 2 cm;
Fig. 3: ***Agaricus wrightii*** (*typus*, AH 16947), bar = 5 cm;
Fig. 4: ***Agaricus wrightii*** (*typus*, AH 16947), a: Pileipellis. b: Basidia. c: Cheilocystidia. d: Spores, bar = 10 µm.

Agaricus xanthoderma Genev.
Rebellin, Valdivia, among grass in ***Nothofagus dombeyi*** forest, 1-VI-1991 (*leg.* J. Grinbergs & S. Garnica), AH 14409. Cordillera Pelada, Valdivia, in ***Nothofagus*** forest and on soil under ***Myrtaceae*** 24-IV-1992 (*leg.* H. Peredo), AH 15260 and AH 15261.

ACKNOWLEDGEMENTS

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REFERENCES

ARORA, D. (1986). *Mushrooms demystified. A comprehensive guide to the fleshy fungi*. Ed. Ten Speed Press. Berkeley.

GARRIDO, N. (1985). Index Agaricalium chilensis. *Biblioth. Mycol.* 99: 1-339.

GARRIDO, N. (1988). Agaricales s. l. und ihre mykorrhizen in den Nothofagus-wäldern mittelchiles. *Biblioth. Mycol.* 120: 1-528.

HEINEMANN, P. (1986). Agarici Austroamericani IV. Aperçu sur les Agaricus de Patagonie et de la Terre de Feu. *Bull. Jard. Bot. Nat. Belg./ Bull. Nat. Plantentuin Belg.* 56: 417-446.

HEINEMANN, P. (1990). Agarici Austroamericani VII. Agariceae des zones tempérées de l`Argentine et du Chili. *Bull. Jard. Bot. Nat. Belg./ Bull. Nat. Plantentuin Belg.* 60: 331-370.

HEINEMANN,P. & RAMMELOO, J. (1985). De la mesure des spores et de son expression. *Agarica* 6(12):366-380.

MURRIL, W. (1912). The Agaricaceae of the Pacific Coast III. *Mycologia* 4: 294-308.

PEGLER, D. (1983). Agaric Flora of the Lesser Antilles. *Kew Bull.Add.Ser.* IX:430-456.

SINGER, R. & MOSER, M. (1965). Forest mycology and forest communities in South America I. The early fall aspect of the mycoflora of the Cordillera Pelada (Chile), with a mycogeographic analysis and conclusions regarding the heterogeneity of the Valdivian floral district. *Mycopathol.Mycol.Appl.* XXVI(2-3): 130-191.

VALENZUELA, E, MORENO, G. & GRINBERGS, J. (1992). Agaricales sensu lato de Chile. I. *Bol. Soc. Micol. Madrid* 17: 81-93.

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MYCORRHIZAE OF ASIAN BLACK TRUFFLES, *TUBER HIMALAYENSE* AND *T. INDICUM.*

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SUMMARY

With the introduction, to Europe, of Asian black truffles, sold like *Tuber melanosporum,* is becoming necessary to get detailed information about their taxonomy and to characterize their mycorrhizae so to distinguish them from those of the European black truffles.

In the present research, mycorrhizae of *Tuber himalayense* and *T. indicum*, obtained by the inoculation of *Quercus pubescens* seedlings with a sporal suspension of the single ascocarps, have been described and characterized. The two mycorrhizal types are very similar and only sometimes can slight differences be observed. From a first comparison of these two mycorrhizal types with those of the European black truffles they appear to have a higher affinity with *T. melanosporum* than *T. aestivum* and their related species.

Key words: truffles; *Tuber himalayense; Tuber indicum*; ectomycorrhizae; characterization

INTRODUCTION

'Black truffles' are underground ascomata with a black and warty peridium. All European black truffles are valuable food. In particular the 'Périgord black truffle' (*Tuber melanosporum* Vitt.), also called the 'black diamond', is the most appreciated in the cuisine. Oaks are the main hosts for these truffles, however hazel, beech, *Ostrya*, birch, pine and spruce can form symbiosis with some species of black truffles.

France, Italy and Spain are the most important producers and exporters, nevertheless recently success in the production of *T. melanosporum* was obtained in the U.S.A. and New Zealand.

Some black truffles are known to grow in Asia. Cooke and Massee (1892) described *T. indicum* from Uttar Pradesh, Northern India, and among the holotypic specimens at Kew Herbarium, a second species, *T. himalayense* B.C. Zhang and Minter (1988), was recognized as valid.

Since 1993 increasing quantities of Asian black truffles begun to reach Europe and to be sold like *T. melanosporum.* Because of their lower prices, they have sometimes been used to produce mycorrhizal plants for truffle farms, introducing a risk of biopollution of European endemic truffle populations.

In this study, we report the morphological characterization of the Asian black truffle ectomycorrhizae with *Quercus pubescens* Willd., one of their potential European hosts. This is the first step toward the construction of an identification-key that could provide a useful tool for the rapid screening of mycorrhizal types formed by infecting host plants with Asian versus European black truffles.

MATERIAL AND METHODS

One year old *Q. pubescens* seedlings, grown axenically in sterile perlite, were inoculated with spore suspension done blending separately single ascocarps. Mycorrhizal plants grew in semisynthetic substratum of vermiculite, calcareous gravel and Sphagnum peat at pH 7.0, and were observed at different times of development.

Methods to characterize ectomycorrhizae have been comprehensively explained by Agerer (1986, 1987-1993, 1991) and the glossary of all terms used have been published by Agerer (1987-1993). For better characterization of ectomycorrhizae colour Munsell® Soil Color Chart (1975) has been used as reference. Cross and longitudinal sections (2-3 µm thick) have been done using cryostat 2800 Frigocutn, Reichert-Jung. Photographs have been made using optical microscopy. For SEM observations, mycorrhizae were fixed in 4% glutaraldeyd, stored in a refrigerator for 1-2 days, dehydrated through an ethanol series (30-99.9%) and then transferred to absolute acetone and critical-point dried (Balzers CPD020) using carbon dioxide as the intermediate fluid. Graphite glue was applied to the base of each specimen before coating with gold layer 150Å thick in a sputter coater (Balzers SCD040). Samples were observed with Philips SEM 505, at 30 kV and photographed using Polaroid 55 film.

Voucher specimens are deposited in AQUI (Herbarium Mycologicum Aquilanum) as fixed material (glutaraldeyd 4%), together with slides.

RESULTS

Tuber himalayense B.C. Zhang and Minter

MORPHOLOGICAL CHARACTERS (Fig. 1- 2A)

Mode of ramification: mostly unramified but also monopodial-pinnate. In few samples monopodial-pyramidal ramifications have been observed; length of the system: from 1000 to 2000 µm; length of unramified ends: from 235 to 1200 µm; diameter of unramified ends: from 150 to 250 µm; diameter of axes: from 150 to 250 µm; shape of unramified ends: straight; structure of the surface: smooth, loosely long-spiny especially in the outer part of the mycorrhizae, even if sometime they are present also in the middle part. Older specimens seem to loose cystidia. Rhizomorphs absent; colour of unramified ends: amber (10 YR 5/8-5/6); colour of very tips: little bit lighter; colour of older parts: from 5 YR. 4/6 to dark brown.

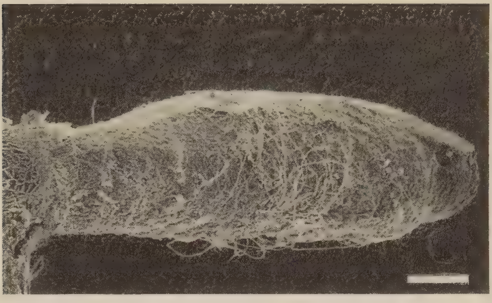


Fig. 1: *Tuber himalayense* mycorrhiza (bar= 0.1 mm).

ANATOMICAL CHARACTERS OF THE SURFACE

OUTER SURFACE OF THE MANTLE (Fig. 2B)

Structure: pseudoparenchymatous, with puzzle-like aspect. Observing single hyphal cells, it can be seen that their shape is rectangular and more or less elongated, frequently ramified, one or more times. Cells are often connected and separated by septa. Hyphal pattern is rather homogeneous; dimensions of hyphal cells: length ranges from (7) 10 to 15 (18) µm, width ranges from 4 to 6 µm.

INNER SURFACE OF THE MANTLE (Fig. 2C)

Structure: plectenchymatous, hyphae are grouped in zones with the same orientation; dimensions of hyphal cells: they are 3.5-4 µm width and 15-20 µm long.

EMANATING HYPHAE

Form: they are often very long, up to 300 µm and present ramifications angle recto-like; septa: abundant; distance: 20-40 µm; diameter: from 2 to 3 µm; thickness of walls: irrelevant; distal ends: bent.

ANATOMICAL CHARACTERS: CROSS SECTION (Fig. 2D)

MANTLE

Thickness and differentiation: mantle is 15-20 µm thick, a thin outermost layer, 2-5 (8) µm thick, is differentiated because hyphal cells are more compact; cells shape and dimensions: in the outermost layer cells are very difficult to measure, the remaining part of the mantle is formed by cells both rounds or with tangential orientation; the former present dimensions ranging from 2-4 x 2-4 µm, the latter measure 5-12 x (2) 3-4 µm.

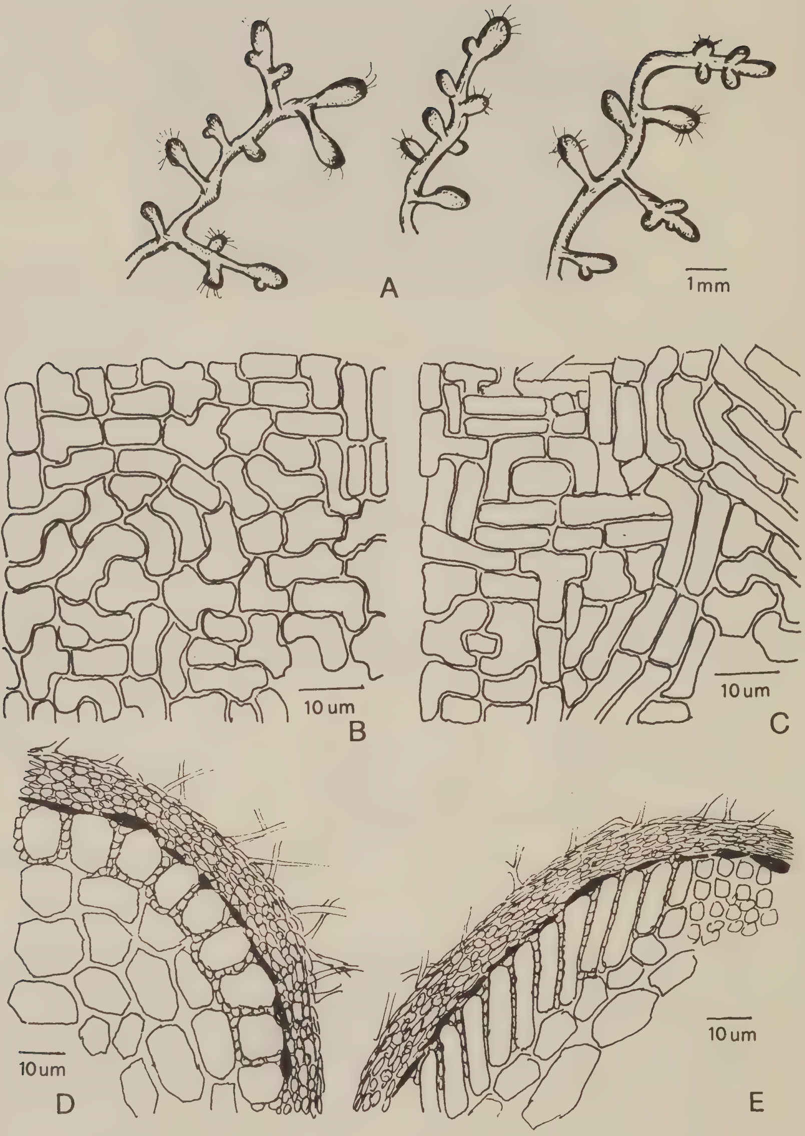

A
1mm
10 um
B
10 um
C
10um
D
10um
E

Fig. 2: *Tuber himalayense* - mycorrhizae (A), outer surface of the mantle (B), inner surface of the mantle (C), cross section (C), longitudinal section (E).

TANNIN CELLS

Number of rows: 1/2; cell-shape and dimensions: sometimes a continuum layer, 3-5 µm thick, is present, normal Tannin Cells present tangential orientation and dimensions of 5-11 x 2-4 µm.

CORTICAL CELLS

Shape and dimensions: roundish or rectangular with both tangential or radial orientation, roundish cells measure 15-17 x 14-15 µm, rectangular ones measure 20-35 x 12-22 µm; number of rows with Hartig'n: 1.

HARTIG NET

Depth: 15-35 µm; thickness: 2-3 µm; number of hyphal rows: 1; shape of hyphal cells and dimensions: roundish/rectangular, 2-3 x 1-1.5 µm.

ANATOMICAL CHARACTERS: LONGITUDINAL SECTION (Fig. 2E)

MANTLE

Thickness and differentiation: 15-20 µm thick, the outer part (2-5 µm) is more compact and cells are not well shaped, the rest part of the mantle is formed by quadrangular or roundish cells (1-3 (5) x 2-4 (7) µm) and rectangular cells (8-11 x 3-5 µm); very tip: presents a very compact structure similar to the outermost mantle of the rest part of mycorrhiza.

TANNIN CELLS

Cell-shape and dimensions: rectangular cells of 15-17 x 2-5 µm or a continuum, 3-4 µm thick.

CORTICAL CELLS

Cell-shape and dimensions: in the first row cells present a radial orientation, in the others rows are tangentially orientated, 20-65 x 10-25 µm.

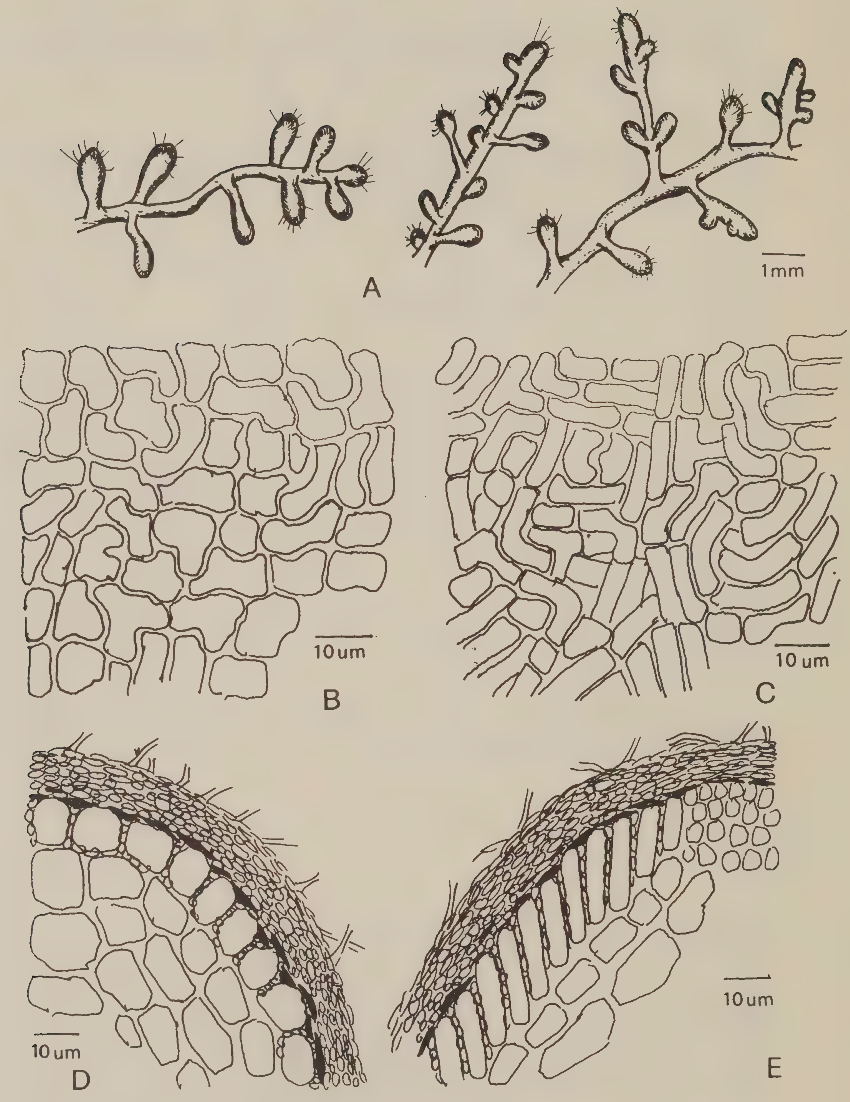
HARTIG NET

Cell-shape and dimensions: roundish/rectangular, 1-2 x 2-3 µm.

Tuber indicum Cooke & Massee

MORPHOLOGICAL CHARACTERS (Fig. 3A)

Mode of ramification: it can be both simple or monopodial-pinnate; length of the system: from 300 to 2000 µm; length of unramified ends: from 150 to 800 µm; diameter of unramified ends: from 150 to 300 µm; diameter of axes: from 120 to 400 µm; shape of unramified ends: straight; structure of the surface: smooth, loosely long-spiny especially on the very tip, even if they can be observed also in the middle part of the mycorrhizae; cystidia have not been observed in old specimens. Rhizomorphs absent; colour of unramified ends: ochreaceus-amber (7.5 YR 6/6); colour of very tips: little bit lighter; colour of older parts: dark brown.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D
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E

Fig. 3: *Tuber indicum* - mycorrhizae (A), outer surface of the mantle (B), inner surface of the mantle (C), cross section (D), longitudinal section (E).

ANATOMICAL CHARACTERS OF THE SURFACE

OUTER SURFACE OF THE MANTLE (Fig. 3B)

Structure: pseudoparenchymatous, very heterogeneous sometime even within the same specimen. Hyphal pattern is generally formed by slightly roundish elements with an irregular perimeter and by more elongated cells. Elongate cells are generally less abundant than the others. The general feature of the surface is frequently puzzle-like even if, observing the singular hyphal cell, it can be noticed that their shapes are regular. Spaces between hyphal cells can been observed; dimensions of hyphal cells: their length can range from (8) 10-16 (20) µm, width ranges from 5 to 10 µm.

INNER SURFACE OF THE MANTLE (Fig. 3C)

Structure: plectenchymatous, hyphae are grouped in several zone with the same orientation; dimensions of hyphal cells: 15-18 (20) µm of length, 3-4 µm width.

EMANATING HYPHAE (Fig. 4)

Form: they are long up to 300 µm, ramifications angle recto-like are frequent; septa: abundant; distance: 25-35 µm; diameter: from 2 to 3 µm; thickness of walls: irrelevant; distal ends: bent.

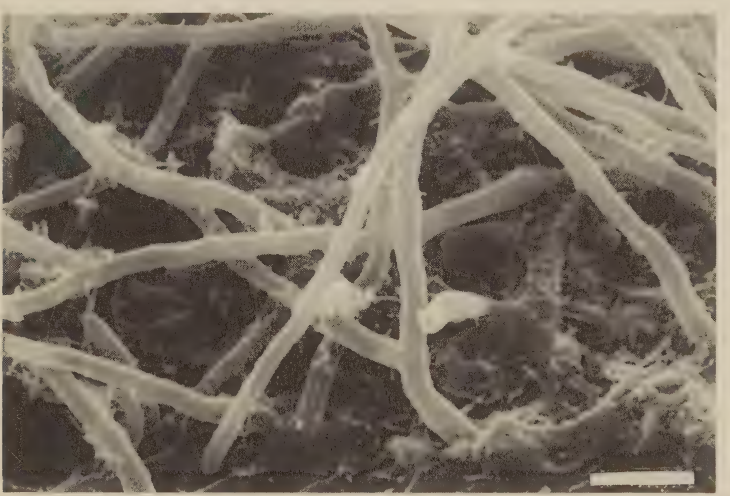

Fig. 4: *T. indicum*, emanating hyphae with angle recto-like ramifications (bar= 10 µm).

ANATOMICAL CHARACTERS: CROSS SECTION (Fig. 3D)

MANTLE

Thickness and differentiation: mantle thickness ranges from 12 to 18 µm; a slight differentiation in an outer part, 3-5 µm thick, in which hyphal cells are more compact, and the rest part of the mantle with well shaped hyphal cells, numerous emanating hyphae depart from the outer part of the mantle; cells shape and dimensions: in the outer part hyphal cells are tangentially elongated and difficult to measure, the rest part of the mantle is formed by cells tangentially elongated (5-12 x 2-4 µm) or roundish/quadrangular (1.5-3 x 1.5-3 µm).

TANNIN CELLS
Number of rows: 1/2; cell-shape and dimensions: tangentially orientated (5-20 x 2-4 µm) sometime instead cells a continuum layer, 3-4 µm thick, can be observed.

CORTICAL CELLS
Shape and dimensions: in the first row Cortical Cells are generally smaller with both roundish (17-25 x 20-22) or elongated shape (20-35 x 15-22); number of rows with Hartig'n: 1.

HARTIG NET
Depth: 15-20 µm; thickness: 1.5-2 µm; number of hyphal rows: 1; shape of hyphal cells and dimensions: quadrangular, 2 x 1-1.5 µm.

ANATOMICAL CHARACTERS: LONGITUDINAL SECTION (Fig. 3E)

MANTLE
Thickness and differentiation: mantle is 15-20 µm thick, in the outer part of 2-6 µm, a layer of very compact and elongate hyphal cells are present, in the rest part of the mantle both roundish/quadrangular (1-3 x 1-3 µm) and tangentially orientated cells (8-11 x 2-5 µm) can be observed; very tip: very compact and similar to the outer part of the mantle.

TANNIN CELLS
Cell-shape and dimensions: very often a continuum layer, 3-4 µm thick is present, when singular cells can be observed they are tangentially orientated (15-17 x 2-5 µm)

CORTICAL CELLS
Cell-shape and dimensions: the first row is formed by very radially orientated cells (20-50 x 8-15 µm), the others are tangentially orientated (30-65 x 15-30 µm).

HARTIG NET
Cell-shape and dimensions: it is not so well observable, 2-3 µm thick.

DISCUSSION

Ascocarps of *T. himalayense* and *T. indicum* are very difficult to separate on a morphological bases. Only spore ornamentation, that is spores with free spines (*T. indicum*) or spines connected by a basal reticulum (*T. himalayense*) should be a clear diagnostic character, however both kinds of spore can be observed sometime within a single ascus (ZHANG & MINTER, 1988). *T himalayense* and *T. indicum* appear clearly related to *T. melanosporum* because of their spiny and black spores.

Identification of ectomycorrhizae at the level of species on the basis of both macro- and microscopic features could be possible, as the Colour Atlas of Ectomycorrhizae (AGERER, 1987-1993) shows. However, not all the mycorrhizae seem to present species-specific features (MEHMANN *et al.*, 1995). BRUNNER (1991) could not find any significant differences in morphology and anatomy between *in vitro*-synthesized ectomycorrhizae of the two species *Hebeloma crustuliniforme* (Bull. : Fr.) Quél. and *H. cylindrosporum* Romagn. on spruce.

From a macroscopic point of view, it is possible to affirm that there are no differences between *Tuber himalayense* and *T. indicum* mycorrhizae on *Q. pubescens*, but it is well known that macroscopic features can been inconsistent and influenced by aging and edaphic conditions (ORLOV, 1960; TRAPPE, 1967; PALENZONA & FONTANA, 1970; EGLI & KÄLIN, 1991). By considering microscopic characters, which are the more stable and less influenced (HAUG, 1987; EGLI *et al.*, 1993), probably only the outermost part of the mantle can give little differences between the two species. The surface view of *T. himalayense* mycorrhizae is quite well defined: hyphal pattern presents always the same features despite the large number of specimens observed (Fig. 2B). Forms and dimensions of hyphal cells are constant.

Rather different is the situation in *T. indicum* which presents a very heterogeneous structure of mantle surface. Some specimens have a hyphal pattern formed by a prevalence of quadrangular cells or, in general, by cells with irregular perimeter with a diameter slighter width respect to those of *T. himalayense* (Fig. 3B). Even the space between hyphal cells is slightly bigger. However, it is not difficult to find, even in the same sample, parts in which the hyphal pattern is quite similar to that of *T. himalayense*. Several of the specimens observed have showed forms with intermediate features in between the two types.

A preliminary comparison of the main microscopical characters of Asian black truffle mycorrhizae with those already known for European black truffles (*T. melanosporum* and *T. aestivum* with their allied species) (ZAMBONELLI *et al.*, 1993; GRANETTI *et al.*, 1995a, 1995b; MEOTTO *et al.*, 1995; ZAMBONELLI *et al.*, 1995) has been done. *T. melanosporum* and *T. aestivum* show a different hyphal pattern of the outer part of the mantle and cystidia structure (ZAMBONELLI *et al.*, 1993). In fact, while *T. aestivum* has a mantle surface with polygonal cells and long yellow-ochreaceus cystidia which form a sort of woolly net around mycorrhizae, *T. melanosporum* and allied species, present a puzzle-like hyphal pattern and spinule-like cystidia sometime with orthogonal single branch. On the basis of observations, we can affirm that Asian black truffles mycorrhizae present a higher affinity with *T. melanosporum* rather than with *T. aestivum*.

Further studies are also required to clarify the taxonomic status of *T. himalayense* and *T. indicum*. The great similarity of both ascocarps and mycorrhizae do not contribute much to shed light on this problem. At this regard, it would be important to collect updated field observations on their geographical distribution and host specificity as well as biochemical and molecular data.

REFERENCES

AGERER, R. (1986) - Studies on ectomycorrhizae II. Introducing remarks on the characterization and identification. Mycotaxon **26**: 473-492

AGERER, R. (1987-1993) - Colour Atlas of Ectomycorrhizae. 1st-7th delivery. Einhorn - Verlag, Schwäbisch Gmünd.

AGERER, R. (1991) - Characterization of Ectomycorrhiza. In: J. R. Norris, D. J. Read & A. K. Varma (Eds.). Techniques for the study of mycorrhiza. Methods in Microbiology **23**, 25-73. Academic Press, London. pp 25-76.

BRUNNER, I. (1991) - Comparative studies on ectomycorrhizae synthesized with various in vitro techniques using *Picea abies* and two *Hebeloma* species. Trees **5**: 90-94.

COOKE, M.C., & MASSEE, G. (1892) - Himalayan truffles. Grevillea **20**:67.

EGLI, S. & KÄLIN, I. (1991) - The root window - a technique for observing mycorrhizae on living trees. Agric. Ecosystems Environ. **28**: 107-110.

EGLI, S., AMIET, R., ZOLLINGER, M. & SCHNEIDER B. (1993) - Characterization of *Picea abies* (L.) Karst. ectomycorrhizas: discepancy between classification according to macroscopic versus microscopic features. Trees 7: 123-129

GRANETTI, B., ANGELINI, P. & RUBINI A. (1995a) - Morfologia e struttura delle micorrize di *Tuber magnatum* Pico e *Tuber borchii* Vitt. con *Tilia plathyphyllos.* Mic. Ital. **24** (2): 27-34.

GRANETTI, B., RUBINI A. & ANGELINI, P. (1995b) - Analisi comparativa morfo-biometrica e strutturale delle micorrize di *Tuber aestivum* Vitt. con alcune piante forestali. Mic. Ital. 24 (2): 48-63.

HAUG, I. (1987) - Licht- und elektronenmikroskopische Untersuchungen an Mykorrhizen von Fichtembeständen in Schwarzwald. Dissertation, Universität Tübingen.

MEHMANN, B., EGLI, S., BRAUS, G.H. & BRUNNER, I. (1995) - Coincidence between molecularly or morphologically classified ectomycorrhizal morphotypes and fruitbodies in a spruce forest. In: Biotechnology of Ectomycorrhizae. Vilberto Stocchi, Paola Bonfante and Marco Nuti (Eds.) Plenum Press, New York. 41-52.

MEOTTO, F., NOSENZO, C. & FONTANA, A. (1995) - Le micorrize delle specie pregiate di *Tuber*. Informatore Agrario **51**: 41-46.

MUNSELL SOIL COLOR CHART (1975) - Munsell Color Company Inc., Baltimora (Md.).

ORLOV, A.Y. (1960) - Growth and modifications with age of the absorbing roots of Link. Bot. Z. **45**: 888-896.

PALENZONA, M. & FONTANA, A. (1970) - Influenza di tipi di suolo su tre forme micorriziche del pino strobo. Alliona **16**: 101-113.

TRAPPE, J.M. (1967) - Pure culture synthesis of Douglas-fir mycorrhizae with species of *Hebeloma, Suillus, Rhizopogon* and *Astreus*. For. Sci. **13**: 121-130.

ZAMBONELLI, A., SALOMONI, S. & PISI, A. (1993) - Caratterizzazione anatomo morfologica delle micorrize di *Tuber* spp. su *Quercus pubescens* Willd. Mic. Ital. 22 (3): 73-90.

ZAMBONELLI, A., SALOMONI, S. & PISI, A. (1995) - Caratterizzazione anatomo-morfologica delle micorrize di *Tuber borchii, Tuber aestivum, Tuber mesentericum, Tuber brumale, Tuber melanosporum* su *Pinus pinea* .Mic. Ital. **24** (2): 119-137.

ZHANG, B.C. & MINTER, D.W. (1988) - *Tuber himalayense* sp. nov. with notes on Himalayan truffles. Trans. Br. Mycol. Soc. **91**: 593-597.

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CORRIGENDUM AND INDEXES (FUNGUS NAMES, HOSTS AND SUBSTRATES) TO FUNGI CANADENSES 1 - 330 (1973 - 1990)

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ABSTRACT

An alphabetical list of the fungus names mentioned in **Fungi Canadenses** 1-330 (1973-1990) and an accompanying corrigendum correcting previously unnoticed errors and updating various names and citations have been compiled. Separate host and substrate indexes to the fungus species have been prepared.

INTRODUCTION

Fungi Canadenses is a series of descriptions and illustrations of Canadian fungi. It was issued at irregular intervals in a loose leaf format in fascicles of ten descriptions by the National Mycological Herbarium (DAOM) of the Biosystematics Research Institute, later the Centre for Land and Biological Resources Research but now the Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada (AAFC), Ottawa, Ontario. The first fascicle appeared in 1973. A total of 330 Fungi Canadenses descriptions were published and distributed free of charge to a restricted mailing list of only 400 individuals and institutions, world-wide. The last fascicle published by AAFC appeared in 1990. Following discussions between Agriculture and Agri-Food Canada and the Canadian Phytopathological Society, an agreement was reached in 1993 to continue publication of **Fungi Canadenses** in the society journal, the **Canadian Journal of Plant Pathology / Revue canadienne de phytopathologie**. The new series was inaugurated with the publication of Fungi Canadenses No. 331, *Gigaspora margarita*, by Yolande Dalpé in volume 16: 229-330. 1994. Another five articles have been published or are in press.

In 1987, an alphabetical list of all the fungus names mentioned in Fungi Canadenses 1 - 300 and a corrigendum updating or correcting various names and citations in the first 300 descriptions were compiled by S.A. Redhead and C.E. Babcock and distributed through AAFC's Fungi Canadenses mailing list. The 1987 fungus name list and corrigendum now have been expanded to include descriptions 301 - 330. Host and substrate indexes have been added.

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CORRIGENDUM

The following notes update various names and citations in Fungi Canadenses 1-330 and correct some recently discovered errors in the original publications. Previously published references which should have been cited are supplied. No attempt is made here to include subsequently collected specimens although some subsequently published reports are cited. The authors thank G. Durrieu (Toulouse, France), R. Watling (Edinburgh, Scotland), J. Parmelee, and R.A. Shoemaker for bringing attention to errors and omissions.

No. 16. *Rhizina undulata*: reported from British Columbia as *R. inflata* by Hone (Postelsia 1906: 241).

No. 49. *Didymella applanata*: the correct authority for the synonymous name *Mycosphaerella rubina* is (Peck) House, Bull. N. Y. State Mus. 233-234: 30. 1920.

No. 52. *Gyromitra infula*: reported from Alberta by Hone (Postelsia 1906: 241-242).

No. 53. *Sphaeronaemella helvellae*: reported on *Gyromitra infula* from Alberta by Hone (Postelsia 1906: 242).

No. 67. *Chlorosplenium versiforme* should now be named *Chlorencoelia versiformis* (Pers.: Fr.) Dixon, Mycotaxon 1: 224. 1975.

No. 84. *Apiosporina morbosa* should now be named *Dibotryon morbosum* (Schwein.: Fr.) Theiss. & H. Sydow (M.E. Barr, Sydowia, 41: 32. 1989). *Sphaeronaema* is the correct spelling of the name given in the NOTES section.

No. 92. *Coleroa rubicola* should now be named *Hormotheca rubicola* (Ellis & Everh.) Corlett & M. E. Barr, Mycotaxon 25: 256. 1986.

No. 93. *Coleroa robertiani* should now be named *Hormotheca robertiani* (Fr.) v. Höhnel (Corlett & M. E. Barr, Mycotaxon 25: 255-256. 1986).

No. 94. *Lysurus gardneri*: Stone (Common edible and poisonous mushrooms of Ontario, Ont. Dept. Agric. Bull. 397: 47-48, fig. 51. 1939) reported *Lysurus borealis* (Burt.) P. Hennings from Ontario. The correct name for this species and that reported in Fungi Canadenses 94 under the name *L. gardneri* is *Lysurus cruciatus* (Lepr. & Mont.) Lloyd, Syn. Known Phall. p. 40. 1909 (basionym: *Aserophallus cruciatus* Leprieur & Montagne, Ann. Sci. Nat. Bot. ser. 3,4: 36. 1845), according to Dring (Kew Bull. 35: 75-79. 1980). *Lysurus gardneri* is another species known from Asia and Africa.

No. 120. *Coleroa plantaginis* should now be named *Hormotheca plantaginis* (Ellis) Corlett & M. E.

Barr, Mycotaxon 25: 256. 1986.

No. 140. *Roestelia brucensis*: HOST: 0,I should be corrected to HOST: I as pycnia are unknown.

No. 142. *Phaeomarasmius rhombosporus*: this species, currently accepted as *Flammulaster rhombosporus*, was reported from England and Michigan, U.S.A. by Watling (Notes Roy. Bot. Gard. Edinburgh 28: 68-71. 1967). Vellinga (Persoonia 13: 10-12. 1986) considers it to be a variety, *Flammulaster carpophilus* (Fr.) Earle var. *rhombosporus* (Atk.) Vellinga. She reported it from Denmark and the Netherlands.

No. 168. *Peziza badioconfusa*: according to Pfister (Mycologia 79: 634. 1987), the correct name for this species is *Peziza phyllogena* M.C. Cooke.

No. 170. *Gerronema pseudogrisella* should read *Gerronema pseudogrisellum*. Currently the name *Rickenella pseudogrisella* (A. H. Smith) Gulden in Gulden, Jenssen & Stordal, Arctic and alpine fungi 1, p. 17, Soppkonsulenten, Oslo. 1985, is accepted.

No. 175. *Phaeomarasmius erinaceus* (Fr.) Romagnesi, Rev. Mycol. 2(N.S.): 195. 1937, is the correct citation for this name.

No. 214. *Marasmius copelandi:* Desjardin (Mycologia 79: 127-130. 1987) reexamined the type of *M. copelandi* and fresh material. He concluded that *M. copelandi*, on oak leaves, was conspecific with *M. olidus* and transferred the latter to *M. copelandi* as a variety. The Canadian collections cited in Fungi Canadenses 214 and Imshaug 2035 from Washington represent a closely allied species, *M. salalis* Desjardin & Redhead (Mycotaxon 29: 307-308. 1987).

No. 232. *Pleospora herbarum*: E.G. Simmons (Sydowia, 38: 284-293. 1985) revised the *Pleospora herbarum/Stemphylium botryosum* complex. *Pleospora tarda* Simmons (op. cit. p. 291), including its *Stemphylium botryosum* anamorph, is the fungus described and illustrated in No. 232. *Pleospora herbarum* sensu stricto is a distinct species with

Stemphylium herbarum Simmons as its anamorph. The type of *Pleospora tarda* was from *Medicago sativa* L. from Ontario.

No. 239. *Stagonospora avenae*: note the correct spelling of the specific epithet here. The teleomorph listed as *Leptosphaeria avenaria* is currently treated as *Phaeosphaeria avenaria* (Weber) O. Eriksson, Arkiv f. Bot., Ser. 2, 6(9): 408. 1967.

No. 240. *Stagonospora nodorum*: the teleomorph listed as *Leptosphaeria nodorum* is currently treated as *Phaeosphaeria nodorum* (Müller) Hedjaroude, Sydowia 22: 79-80. 1968.

No. 244. *Septoria tritici*: the correct authority for the teleomorph *Mycosphaerella graminicola* is (Fuckel) Schröter in Cohn, Kryptog.-Fl. Schlesien 3(2): 340. 1893 [Nov. 1894].

No. 249. *Sowerbyella imperialis*: note that the correct spelling of the synonym is *Sowerbyella unicolor*.

No. 263. *Puccinia blyttiana*: the correct binomial for *P. blyttiana* is *P. gibberulosa* Schröt. in Cohn, Beitr. Biol. Pflan. 31(1): 62. 1879. Jørstad (Blyttia 8: 81-90. 1950) noted the similarity of *P. gibberulosa* to *P. blyttiana* and that Schröter's name was the earliest valid one. At that time Jørstad retained Lagerheim's binomial because he was unable to locate the Schröter specimen for comparison. Durrieu collected a microform rust on *Ranunculus alpestris* L. from the Pyrenees Mts. (type location of *P. gibberulosa*). Hennen (Mycologia 66: 553. 1974) examined Durrieu's collection and designated it as neotype for *P. gibberulosa* and reduced *P. blyttiana* to synonymy.

No. 287. *Psilocybe bulbosa*: *Deconia bulbosa* should read *Deconica bulbosa*.

No. 288. *Cumminsiella mirabilissima*: *Uromyces sanquineus* should read *Uromyces sanguineus*, *Uropyxis sanginea* should read *Uropyxis sanguinea*, *Cumminsiella sanquinea* should read *Cumminsiella* *sanguinea.*

No. 298. *Uromyces eugentianae*: *Puccinia halenia* in the Key should read *Puccinia haleniae.*

No. 319. *Laccaria maritima*: NOTES: paragraph 2, line 1, *Laccaria trullicata* should read *Laccaria trullisata.*

COMPREHENSIVE ALPHABETICAL LIST OF SCIENTIFIC NAMES AND COMMON NAMES IN FUNGI CANADENSES 1-330 AND THE CORRIGENDUM

Listed synonyms and other fungus names mentioned in the 'NOTES' section of each Fungi Canadenses publication are included. Italicized fungus names represent new names, new combinations etc. Names with bold numbers indicate descriptions are supplied under those names. Text in square brackets [] was not given in the original publications. Names treated in the corrigendum are cross indexed to the original number, eg. Coleroa rubicola, **92**, 120, corrig. to 92; Hormotheca rubicola, corrig. to 92. Dichotomous keys were included in a number of Fungi Canadenses publications. These are designated by the word ‘key’ in brackets following the original fungus name and number provided, eg. Roestelia brucensis, **140** (key).

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HOST LIST

Fungus species designated with an asterix [*] had been reported in *Fungi Canadenses* 1 - 330 to occur on particular hosts in other countries but had not been reported from Canada on these hosts. In the case of some Agaricales, mycorrhizal and other fungi, suspected, presumed or unconfirmed plant associations [designated with a ?] are included here, i.e., fungus species known only from the rhizosphere of or from soil near specific plants.

Abies

Amylocorticium cebennense
Bactrodesmium betulicola
Bactrodesmium cedricola
Cordana pauciseptata
Marasmiellus filopes
Paecilomyces farinosus
?Peziza phyllogena
Phyllosticta multicorniculata
Sclerotinia kerneri
Sporidesmium larvatum
Taeniolella rudis

Acer

?Amylocorticium cebennense
Bactrodesmium spilomeum
Brachysporium nigrum
Calonectria decora
Cordana pauciseptata
Endophragmiella bisbyi
Endophragmiella collapsa
Endophragmiella subolivacea
Endoxylina allantospora
Flammulaster rhombosporus
Helminthosporium velutinum
?Hygrocybe spadicea
Massaria inquinans
Neobulgaria pura
Oedocephalum cristallinum
Paecilomyces farinosus
Peziza varia
Phyllosticta minima
Pseudospiropes nodosus
Pseudospiropes simplex
Spadicoides atra
Sporidesmium foliculatum
Steganosporium acerinum

Steganosporium ovatum
?Tylopilus rubrobrunneus

Achillea
?Laccaria maritima

Aegilops
Puccinia striiformis II,III
Puccinia triticina II,III (also Thalictrum)

Aesculus
Phyllosticta sphaeropsoidea

Agrimonia
Sphaerotheca macularis

X Agrohordeum
Pseudoseptoria stomaticola

Agropyron
Erysiphe graminis
Lagena radicicola
Olpidium brassicae
Polymyxa graminis
Pseudoseptoria stomaticola
Puccinia striiformis II,III
Septoria elymi

Agrostis
Gaeumannomyces graminis var. tritici
Lagena radicicola
Olpidium brassicae

Allium
Glomus constictum
Petriella sordida
Sclerocystis rubiformis

Alnus
Bactrodesmium biformatum
?Cystoderma lilacipes
Endophragmiella angustispora
Endophragmiella collapsa
Endophragmiella pallescens
Flammulaster rhombosporus
Helminthosporium velutinum
Phaeomarasmius erinaceus
Pseudospiropes nodosus
Pseudospiropes simplex
Spadicoides klotzschii
Sporidesmium foliculatum
Sporidesmium hormiscioides
Taeniolella alta

Althaea
Puccinia malvacearum III

Amaranthus
Lagena radicicola
Olpidium brassicae
Polymyxa betae

Ambrosia
Olpidium brassicae
Puccinia xanthii III

Amelanchier
Apiosporina collinsii
Calonectria decora
Gymnosporangium clavariiforme 0,I (also Juniperus)
Gymnosporangium clavipes 0,I (also Juniperus)
Gymnosporangium inconspicuum 0,I (also Juniperus)
Gymnosporangium nelsonii 0,I (also Juniperus)
Gymnosporangium nidus-avis 0,I (also Juniperus)
Phaeomarasmius erinaceus

Anaphalis
Didymosphaeria conoidea
?Sclerocystis rubiformis

Anchusa
*Puccinia recondita 0,I (also Secale)

Androsace
Puccinia volkartiana III

Anemone

Puccinia anemones-virginianae III
Puccinia gigantispora 0,I,III
Puccinia pulsatillae III

Anthemis

Olpidium brassicae
Lagena radicicola

Aphyllophorales (fungi)

Diplococcium clarkii

Arabidopsis

Puccinia subnitens 0,I (also Distichlis)

Arabis

Puccinia holboellii 0,III

Aralia

Nyssopsora clavellosa III

Araucaria

Phyllosticta acicola

Arbutus

Amylocorticium cebennense

Arctagrostis

Pseudoseptoria stomaticola

Arctium

Olpidium brassicae
Scopinella solani

Arnica

Didymella delphinii
Entyloma arnicale
Puccinia arnicalis II,III

Aronia (=Photinia)

Gymnosporangium clavipes 0,I (also Juniperus)

Artemisia

?Glomus aggregatum
?Glomus constrictum

Asclepias

?Glomus aggregatum

Asparagus

Glomus aggregatum
Glomus mosseae
Sclerocystis rubiformis

Aster

Cercosporella virgaureae

Asteridiella (fungi)

Spiropes helleri

Astragalus

Uromyces lapponicus var. lapponicus 0,I,III
Uromyces phacae-frigidae III
Uromyces punctatus II,III (also Euphorbia)

Athyrium

?Pseudobaeospora pillodii

Avena

Dendryphion nanum
Erysiphe graminis
Fusarium sporotrichioides var. sporotrichioides
?Glomus constrictum
Lagena radicicola
Olpidium brassicae
Pseudoseptoria stomaticola
Puccinia coronata var. avenae II,III (also Rhamnus)
Stagonospora avenae

Balsamorhiza

Puccinia balsamorhizae 0,II,III

Beckmannia
Erysiphe graminis

Beta
Lagena radicicola
Petriella sordida
Polymyxa betae

Betula
Atopospora betulina
Bactrodesmium betulicola
Bactrodesmium spilomeum
Brachysporium nigrum
Brachysporium obovatum
Ciboria betulicola
Cordana pauciseptata
?Cortinarius calopus
?Cystoderma lilacipes
Diaporthe alleghaniensis
Discina korfii
Endophragmiella biseptata
Helminthosporium velutinum
Neobulgaria pura
Phaeomarasmius erinaceus
Pseudospiropes simplex
Spadicoides atra
Sporidesmium foliculatum
Taeniolella exilis
?Tricholoma fulvum
Tyromyces kmetii

Bidens
Olpidium brassicae

Blasia (liverwort)
Rickenella pseudogrisella

Brassica
Dendryphion nanum
Lagena radicicola
Olpidium brassicae
Paecilomyces variotii
Pleospora tarda

Bromus
Fusarium poae
Lagena radicicola
Olpidium brassicae
Pseudoseptoria bromigena
Septoria bromi
Stagonospora nodorum

Buxus
Microthyrium macrosporum

Cakile
?Glomus constrictum

Calamovilfa
?Glomus aggregatum
?Glomus constrictum

Caltha
Puccinia areolata 0,I,II,III
Puccinia calthae 0,I,II,III
Puccinia calthicola 0,I,II,III
Puccinia gemella III
Puccinia treleasiana III

Campanula
Coleosporium campanulae II,III (also Pinus)
Puccinia campanulae III

Capsella
Lagena radicicola

Capsicum
Colletotrichum coccodes
Petriella sordida

Carex
Calyptella capula
Melanodothis caricis
Melanotus caricicola
Mycena cariciophila
Olpidium brassicae
Puccinia karelica ssp. karelica II,III (also Trientalis)
Puccinia karelica ssp. laurentina II,III (also Trientalis)
Puccinia limosae II,III (also

Lysimachia)

Carpinus
Diatrype albopruinosa

Carya
Bactrodesmium obovatum
Endophragmiella cesatii
Phragmocephala stemphylioides var. parva

Celastrus
Bactrodesmium betulicola
Bactrodesmium pithoideum

Cephalanthus
?Massaria lantanae

Cerastium
Lagena radicicola

Chamaedaphne
Marasmiellus paludosus
Psilachnum cassandrae

Chenopodium
Lagena radicicola
Olpidium brassicae
Polymyxa betae
Puccinia subnitens 0,I (also Distichlis)

Chimaphila
Phyllosticta pyrolae

Chrysanthemum
Petriella sordida

Cirsium
Calyptella capula

Cladonia/Cladina (lichenized fungi)
?Cortinarius calopus

Clavaria (s.l.) (fungi)
Eleutheromyces subulatus

Collomia
Sphaerotheca macularis

Cornus
Helminthosporium velutinum
Pseudomassaria corni

Corylus
Diatrype albopruinosa
Helicogloea farinacea
Helminthosporium velutinum
Phaeomarasmius erinaceus
Pseudospiropes nodosus

Cotoneaster
Gymnosporangium clavipes 0,I (also Juniperus)

Crataegus
Gymnosporangium betheli 0,I (also Juniperus)
Gymnosporangium clavariiforme 0,I (also Juniperus)
Gymnosporangium clavipes 0,I (also Juniperus)
Gymnosporangium connersii 0,I (also Juniperus)
Gymnosporangium globosum 0,I (also Juniperus)
Gymnosporangium inconspicuum 0,I (also Juniperus)

Crocus
Papulaspora sepedonioides

Cucumis
Didymella bryoniae
Petriella sordida

Cucurbita
Colletotrichum coccodes
Didymella bryoniae

Cucurbitaceae
Didymella bryoniae

Cydonia
Gymnosporangium clavariiforme 0,I (also Juniperus)

Gymnosporangium clavipes 0,I
  (also Juniperus)

Cytisus
Helminthosporium velutinum
Pleiochaeta setosa

Cytospora (fungi)
Endophragmiella pallescens

Dactylis
Erysiphe graminis
Lagena radicicola
Olpidium brassicae

Dahlia
Dendryphion nanum

Daucus
Olpidium brassicae

Delphinium
*Didymella delphinii

Deschampsia
Pseudoseptoria stomaticola

Diapensia
Apiothyrium arcticum

Diatrype (fungi)
Endophragmiella subolivacea

Dibotryon morbosum
(fungi)
Scopinella sphaerophila

Digitaria
Olpidium brassicae

Distichlis
Puccinia subnitens II,III
  (also Glaux)

Dodecatheon
Puccinia ortonii 0,I,II,III
Uromyces acuminatus 0,I (also
  Spartina)

Draba
Puccinia holboellii 0,III

Dryas
Marasmius epidryas

Echinochloa
Lagena radicicola
Olpidium brassicae

Elymus
Erysiphe graminis
Fusarium sporotrichioides
  var. sporotrichioides
?Glomus aggregatum
?Glomus constrictum
?Laccaria maritima
Pseudoseptoria stomaticola
Puccinia striiformis II,III
Septoria elymi

Elytrigia
Puccinia striiformis II,III

Empetrum
?Cortinarius calopus
?Cystoderma lilacipes
Marasmiellus paludosus

Epilobium
Venturia adusta

Equisetum (Calamophyta)
?Cortinarius calopus

Erigeron
Cercosporella virgaureae

Eriophorum
?Laccaria maritima

Erysimum
Olpidium brassicae
Puccinia holboellii 0,III

Euonymus
Phyllosticta celastrina

Euphorbia

?Glomus constrictum
*Uromyces punctatus 0,I (also Astragalus, Oxytropis)

Fagopyrum
Lagena radicicola

Fagus
Bactrodesmium spilomeum
Brachysporium nigrum
Diatrype albopruinosa
Diatrype virescens
Neobulgaria pura
Pseudospiropes simplex
Spadicoides grovei
Spadicoides obovata
Sporidesmium foliculatum
?Tylopilus rubrobrunneus

Festuca
Dendryphion nanum
?Laccaria maritima
Pseudoseptoria stomaticola

Filipendula
Sphaerotheca macularis

Fragaria
?Glomus aggregatum
?Glomus constrictum
?Sclerocystis rubiformis

Fraxinus
Brachysporium nigrum
Pseudospiropes simplex

Gaillardia
Stigmina dothideoides

Galeopsis
Didymosphaeria conoidea

Gaultheria
Marasmium salalis
Phyllosticta gaultheriae

Gaylussacia
Marasmiellus paludosus

Gentiana
Puccinia gentianae *0,*I,II,III
Uredo beringiana II

Gentianella
Uromyces eugentianae II,*III

Geranium
Hormotheca robertiani
Puccinia leveillei III
Sphaerotheca macularis
Uromyces geranii 0,I,II,III

Geum
Puccinia urbanis III
Sphaerotheca macularis

Gladiolus
Papulaspora sepedonioides

Glaux
Puccinia distichlidis 0,I (also Spartina)
Puccinia subnitens 0,I (also Distichlis)

Gleditsia
*Aglaospora profusa

Glycine
Dendryphion nanum
?Glomus constrictum
?Glomus mosseae
Petriella sordida

Gnaphalium
Olpidium brassicae

Gyromitra (fungi)
Sphaeronaemella helvellae

Halenia
Puccinia haleniae III

Hamamelis
Phyllosticta hamamelidis

Helianthus
Papulaspora sepedonioides

Puccinia helianthi 0,I,II,III

Hieracium
?Glomus aggregatum

Hierochloe
Erysiphe graminis
Stagonospora nodorum

Hordeum
Erysiphe graminis
Eurotium echinulatum
Fusarium sporotrichioides var. sporotrichioides
Lagena radicicola
Olpidium brassicae
Polymyxa graminis
Pseudoseptoria stomaticola
Puccinia hordei II,III (also Ornithogalum)
Puccinia striiformis II,III
Septoria passerinii
Stagonospora nodorum

Humulus
Sphaerotheca macularis

Hyphoderma (fungi)
Diplococcium clarkii

Iberis
Puccinia subnitens 0,I (also Distichlis)

Impatiens
Lagena radicicola

Iris
Puccinia iridis II,*III

Iva
Puccinia intermixta 0,I,III

Juncus
Melanotus caricicola

Juniperus
Eutryblidiella sabina
Gymnosporangium betheli III (also Crataegus)
Gymnosporangium clavariiforme III (also Amelanchier, Crataegus, Cydonia, Pyrus)
Gymnosporangium clavipes III (also Amelanchier, Aronia, Cotoneaster, Crataegus, Cydonia, Malus, Sorbus)
Gymnosporangium connersii III (also Crataegus)
Gymnosporangium cornutum III (also Malus, Sorbus)
Gymnosporangium fuscum III (also Pyrus)
Gymnosporangium gaeumannii ssp. albertense II(III)
Gymnosporangium globosum III (also Crataegus, Pyrus)
Gymnosporangium inconspicuum III (also Amelanchier, Crataegus)
Gymnosporangium juniperi-virginianae III (also Malus)
Gymnosporangium nelsonii III (also Amelanchier, Malus)
Gymnosporangium nidus-avis III (also Amelanchier)
Gymnosporangium tremelloides III (also Sorbus)
?Hygrocybe spadicea
Roestelia brucensis I

Lactuca
Calyptella capula
Olpidium brassicae

Larix
Capnobotrys sessilispora

Lathyrus
Calyptella capula
?Glomus aggregatum

Ledum
Lophodermium sphaerioides

Lepidium
Puccinia subnitens 0,I (also Distichlis)

Lepidoptera (larva or

pupa)
Paecilomyces breviramosus
Paecilomyces farinosus
Paecilomyces tenuipes

Leptosphaeria (fungi)
Didymosphaeria conoidea

Linnaea
Metacoleroa dickiei

Linum
Paecilomyces variotii

Lithospermum
*Puccinia recondita 0,I (also Secale)

Lobelia
Puccinia lobeliae III

Lycium
Puccinia tumidipes II,III

Lycopersicon
Colletotrichum coccodes

Lycopsis
*Puccinia recondita 0,I (also Secale)

Lysimachia
Puccinia dayi III
Puccinia distichlidis 0,I (also Spartina)
*Puccinia limosae 0,I (also Carex)
Uromyces acuminatus 0,I (also Spartina)

Mahonia
Cumminsiella mirabilissima 0,I,II,III

Malus
Gymnosporangium clavipes 0,I (also Juniperus)
Gymnosporangium cornutum 0,I (also Juniperus)
Gymnosporangium juniperi-virginianae 0,I (also Juniperus)
Gymnosporangium nelsonii 0,I (also Juniperus)
Petriella sordida
Venturia asperata
Venturia inaequalis

Malva
Puccinia malvacearum III

Massaria (fungi)
Calonectria decora

Medicago
Calyptella capula
?Glomus constrictum
Glomus mosseae
Olpidium brassicae
Pleospora tarda

Melica
Erysiphe graminis

Melilotus
Dendryphion nanum
?Glomus aggregatum

Monolepis
Puccinia subnitens 0,I (also Distichlis)

Muhlenbergia
Puccinia schedonnardi II,*III (also Sphaeralcea)

Musci (mosses)
Cantharellula umbonata
Flammulaster rhombosporus
Gyromitra infula
Hohenbuehelia longipes
Hygrophorus hyacinthinus

Myrica
?Cortinarius calopus

Nicotiana
?Sclerocystis rubiformis

Oenothera
?Sclerocystis rubiformis
Scopinella solani

Oplopanax
?Pseudobaeospora pillodii

Ornithogalum
*Puccinia hordei (also Hordeum)

Ostrya
Ciboria betulicola
Diatrype albopruinosa
Helicogloea farinacea

Oxalis
?Glomus constrictum
*Puccinia sorghi 0,I (also Zea)

Oxytropis
?Paecilomyces carneus
?Paecilomyces farinosus
Uromyces lapponicus var. oxytropis I
Uromyces punctatus II,III (also Euphorbia)

Panax
Puccinia araliae III

Parnassia
Puccinia parnassiae III

Parthenocissus
Phyllosticta ampelicida

Peniophora (fungi)
Endophragmiella pallescens

Petasites
Puccinia conglomerata III

Phaseolus
?Glomus constrictum
?Glomus mosseae

Phleum
Dendryphion nanum
Olpidium brassicae
Pseudoseptoria stomaticola

Physalis
Aecidium physalidis 0,I
Puccinia physalidis III

Physocarpus
Sphaerotheca macularis

Picea
Amylocorticium subincarnatum
?Bactrodesmium moenitum
Bactrodesmium obliquum var. obliquum
Bactrodesmium rahmii
Capnobotrys neesii
Capnobotrys sessilispora
Cordana pauciseptata
?Cortinarius calopus
?*Endophragmiella biseptata
Helicogloea farinacea
Marasmiellus filopes
Mariannaea elegans
?Paecilomyces carneus
?Peziza phyllogena
Taeniolella rudis

Pinguicula
Ustilago pinguiculae

Pinus
Amylocorticium canadense
Amylocorticium cebennense
Amylocorticium subincarnatum
*Coleosporium campanulae 0,I (also Campanula)
Endophragmiella biseptata
Marasmiellus filopes
?Paecilomyces fumosoroseus
?Paecilomyces lilacinus
Paecilomyces variotii
?Peziza phyllogena
Spadicoides atra
Sporidesmium larvatum
Therrya fuckelii

Piptoporus (fungi)
Eleutheromyces subulatus

Pisum
Coniella pulchella
Microascus longirostris
Paecilomyces variotii
Petriella sordida
Pleospora tarda

Plantago
Hormotheca plantaginis
Olpidium brassicae
Puccinia subnitens 0,I (also Distichlis)

Poa
Erysiphe graminis
Lagena radicicola
Olpidium brassicae
Pseudoseptoria stomaticola

Podophyllum
Puccinia podophylli 0,I,III

Polygonum
Cercospora avicularis
Lagena radicicola
Olpidium brassicae
Uromyces polygoni-avicularis 0,I,II,III

Polytrichum (moss)
Cantharellula umbonata
Cystoderma lilacipes
?Laccaria maritima

Populus
Arachnophora excentrica
Athelopsis glaucina
Bactrodesmium spilomeum
Brachysporium nigrum
Brachysporium obovatum
Connersia rilstonii
Cucurbitaria staphula
Dactylosporium macropus
Diplococcium clarkii
Endophragmiella bisbyi
Endophragmiella biseptata
Endophragmiella pallescens
Flammulaster rhombosporus
Helicogloea farinacea
Helicoma morgani
Marssonina brunnea
Marssonina castagnei
Marssonina populi
Paecilomyces carneus
?Paecilomyces marquandii
Peziza phyllogena
Phaeomarasmius erinaceus
Phragmocephala prolifera
Pseudospiropes nodosus
Pseudospiropes simplex
Spadicoides bina
Spadicoides canadensis
Sporidesmium brachypus
Sporidesmium foliculatum
Stigmina robusta

Portulaca
Lagena radicicola

Potentilla
?Cortinarius calopus
Frommeëlla tormentillae 0,II^{1},II^{2},III
?Glomus aggregatum
?Laccaria maritima
Phragmidium potentillae *0,I,II,III
Sphaerotheca macularis

Prunus
Diatrype albopruinosa
Dibotryon morbosum
Fusarium sporotrichioides var. sporotrichioides
Monilinia fructicola
Pseudospiropes nodosus

Pseudotsuga
Bactrodesmium obliquum var. suttonii
Marasmiellus pluvius
Marasmius salalis
Mariannaea elegans
Paecilomyces carneus
Rhizina undulata

Puccinellia
Erysiphe graminis
Pseudoseptoria stomaticola

Pyrola
Phyllosticta pyrolae

Pyrus

Gymnosporangium clavariiforme 0,I (also Juniperus)
Gymnosporangium fuscum 0,I (also Juniperus)
Gymnosporangium globosum 0,I (also Juniperus)
Venturia pirina

Quercus

Diatrype albopruinosa
Exidia recisa
Helminthosporium velutinum
Pseudospiropes simplex
Spadicoides grovei
Sporidesmium foliculatum
Sporidesmium hormiscioides
Taeniolella alta

Ranunculus

Leptotrochila ranunculi
Pseudopeziza singularis
Puccinia gibberulosa III
Puccinia ustalis III

Raphanus

Petriella sordida

resupinate Basidiomycete (fungi)

Endophragmiella verticillata

Rhamnus

Puccinia coronata var. avenae 0,I (also Avena)

Rhinanthus

?Laccaria maritima

Rhododendron

Botryosphaeria rhodorae
Cercospora handelii
Fusarium sporotrichioides var. sporotrichioides

Rhus

Phyllosticta toxica
Pileolaria brevipes 0,II^1,II^2,III
Sphaerotheca macularis

Ribes

Ramularia coalescens

Robinia

Aglaospora profusa

Roegneria

Puccinia striiformis II,III

Rorippa

Olpidium brassicae

Rosa

Phragmidium fusiforme var. noviboreale 0,I,II,III
Sphaerotheca macularis

Rubus

Coleroa chaetomium
?Cortinarius calopus
Didymella applanata
Fabraea cincta
Helminthosporium velutinum
Hormotheca rubicola
Kuehneola uredinis 0,II^1,II^2,III
Phragmidium arcticum I,II,III
Phragmidium occidentale 0,I,II,III
Sphaerotheca macularis

Rumex

?Glomus constrictum
Olpidium brassicae
?Sclerocystis rubiformis
Venturia canadensis
Venturia rumicis

Salix

Bactrodesmium traversianum
Flammulaster rhombosporus
Helicogloea farinacea
Phaeomarasmius erinaceus
Pseudospiropes simplex
Venturia chlorospora
Venturia minuta
Venturia saliciperda
Venturia subcutanea

Sambucus

Dendryphion comosum
Helminthosporium velutinum
Phragmocephala elliptica
Pseudospiropes nodosus

Sanguisorba
Sphaerotheca macularis
Xenodochus carbonarius *0,*I,*I^{II},III

Sarcobatus
Puccinia subnitens 0,I (also Distichlis)

Saxifraga
Melampsora hirculi I,II,III

Scirpus
Melanotus caricicola

Sclerotinia (fungi)
Fusarium sporotrichoides var. sporotrichioides

Secale
Erysiphe graminis
Olpidium brassicae
Polymyxa graminis
Pseudoseptoria stomaticola
Puccinia recondita II,III (also Anchusa, Lithospermum & Lycopsis)
Puccinia triticina II,III (also Thalictrum)

Silene
?Glomus constrictum

Silphium
Puccinia silphii III

Sinapis
Olpidium brassicae

Smelowskia
Puccinia codyi 0,III

Smilacina
Phyllosticta pallidior

Smilax
?Glomus aggregatum

Solanum
Colletotrichum coccodes
Helminthosporium solani

Solidago
Cercosporella virgaureae
?Glomus constrictum

Sorbus
Gymnosporangium clavipes 0,I (also Juniperus)
Gymnosporangium cornutum 0,I (also Juniperus)
Gymnosporangium tremelloides 0,I (also Juniperus)
Pseudospiropes simplex

Spartina
Puccinia distichlidis II,III (also Glaux, Lysimachia)
Uromyces acuminatus II,III (also Dodecatheon, Lysimachia)

Sphaeralcea
Puccinia schedonnardi 0,I (also Muhlenbergia)
Puccinia sherardiana 0,III

Sphagnum (Musci)
Endogone pisiformis
Marasmiellus paludosus
Omphalina brevibasidiata

Spinacia
Lagena radicicola
Pleospora tarda
Polymyxa betae

Spiraea
Helminthosporium velutinum
Sphaerotheca macularis

Stellaria
Olpidium brassicae

Symphytum

Calyptella capula

Tagetes
Glomus aggregatum
Glomus constrictum
Sclerocystis rubiformis

Taraxacum
Lagena radicicola
Olpidium brassicae

Taxus
Spiropes helleri

Thalictrum
*Puccinia triticina 0,I (also Aegilops, Secale, Triticum)

Thlaspi
Lagena radicicola
Olpidium brassicae

Thuja
Bactrodesmium obliquum var. suttonii
Marasmiellus pluvius
?Paecilomyces carneus
?Paecilomyces fumosoroseus
?Paecilomyces marquandii
?Paecilomyces variotii
Phyllosticta thujae
?Pseudobaeospora pillodii
Sporidesmium larvatum
Taeniolella rudis

Tilia
Endophragmiella subolivacea
Helminthosporium oligosporum
Peziza varia

Trautvetteria
Puccinia trautvetteriae III

Tribonema (alga)
Rhizophydium granulosporum

Trientalis
Puccinia karelica ssp. karelica I (also Carex)
Puccinia karelica ssp. laurentina I (also Carex)

Trifolium
Fusarium sporotrichioides var. sporotrichioides
Olpidium brassicae
Pleospora tarda
Stemphylium sarciniforme

Triglochin
Pleospora tarda

Triticum
Erysiphe graminis
Eurotium echinulatum
Fusarium poae
Fusarium sporotrichioides var. sporotrichioides
Gaeumannomyces graminis var. tritici
Glomus constrictum
Lagena radicicola
Olpidium brassicae
Polymyxa graminis
Pseudoseptoria stomaticola
Puccinia striiformis II,III
Puccinia triticina II,III (also Thalictrum)
Septoria tritici
Stagonospora nodorum
Tilletia controversa

Tsuga
Bactrodesmium obliquum var. suttonii
?Marasmius salalis
?Peziza phyllogena
?Pseudobaeospora pillodii

Typha
Fusarium sporotrichioides var. sporotrichioides
Psathyrella typhae

Ulmus
Calonectria decora
Diatrype albopruinosa
Helminthosporium velutinum
Peziza varia
Sowerbyella imperialis
Sporidesmium brachypus

Sporidesmium foliculatum

Urtica
Dendryphion comosum
Didymosphaeria conoidea

Vaccinium
?Cortinarius calopus
?Cystoderma lilacipes
Lophodermium maculare
Lophodermium melaleucum
Pithoascus intermedius
Trichurus spiralis

Valsa (fungi)
Endophragmiella subolivacea

Vernonia
Puccinia longipes
*0,*II^1,*II^2,III

Veronica
Olpidium brassicae
?Sclerocystis rubiformis

Viburnum
Massaria lantanae

Vicia
Coniella pulchella

Vinca
Phyllosticta pervincae

Viola
Puccinia canadensis III
Puccinia fergussonii III
Puccinia glacieri III
Puccinia ornatula III
Puccinia violae ssp. americana 0,I,II,III
Puccinia violae ssp. violae 0,I,II,III

Vitis
Phyllosticta ampelicida

Xanthium
Pucinia xanthii III

Yucca
Phyllosticta yuccae

Zanthoxylum
Massaria zanthoxyli

Zea
Dendryphion nanum
Fusarium poae
Fusarium sporotrichioides var. sporotrichioides
?Glomus aggregatum
?Glomus constrictum
Lagena radicicola
Microascus longirostris
Olpidium brassicae
Paecilomyces variotii
Puccinia sorghi II,III (also Oxalis)

SUBSTRATE - HABITAT LIST

air
Microascus longirostris
Trichurus spiralis

bark
Arachnophora excentrica
Bactrodesmium betulicola
Bactrodesmium cedricola
Bactrodesmium obliquum var. obliquum
Bactrodesmium obliquum var. suttonii
Bactrodesmium pithoideum
Bactrodesmium rahmii
Bactrodesmium spilomeum
Brachysporium nigrum
Brachysporium obovatum
Connersia rilstonii
Cordana pauciseptata
Cucurbitaria staphula
Endophragmiella bisbyi
Endophragmiella biseptata
Endophragmiella collapsa

Endophragmiella ontariensis
Endophragmiella pallescens
Eutryblidiella sabina
Helicogloea farinacea
Helicoma morgani
Helminthosporium velutinum
Hemimycena tortuosa
Massaria lantanae
Massaria zanthoxyli
Neobulgaria pura
Phragmocephala elliptica
Phragmocephala prolifera
Pseudospiropes nodosus
Pseudospiropes simplex
Sowerbyella imperialis
Spadicoides atra
Spadicoides bina
Sporidesmium foliculatum
Sporidesmium larvatum
Steganosporium acerinum
Steganosporium ovatum
Stigmina robusta
Taeniolella exilis
Taeniolella rudis

buds
Didymella applanata

burned or open forest
Hygrocybe spadicea

cambium
Helicoma morgani

canes (raspberry)
Didymella applanata

catkins
Ciboria betulicola
Flammulaster rhombosporus

coniferous forest
Agaricus semotus
Hygrophorus hyacinthinus
Tricholoma fulvum

coniferous needle beds
Marasmiellus filopes
Marasmiellus pluvius
Peziza phyllogena

corms
Papulaspora sepedonioides

coastal rain forests
Marasmiellus pluvius

culms
Gaeumannomyces graminis var. tritici
Stagonospora avenae

duff
Discina korfii
Discina macrospora

dung, manure (mammalian)
Flammulaster rhombosporus
Lysurus cruciatus
Microascus longirostris
Petriella sordida
Trichurus spiralis

fleshy fungi
Eleutheromyces subulatus
Endogone pisiformis

flowers
Fusarium sporotrichioides var. sporotrichioides
Melanodothis caricis
Monilinia fructicola
Puccinia holboellii
Scopinella solani
Tilletia controversa
Ustilago pinguiculae
Venturia inaequalis

fruit
Didymella bryoniae
Gymnosporangium clavariiforme
Gymnosporangium clavipes
Gymnosporangium connersii
Gymnosporangium inconspicuum
Gymnosporangium juniperi-virginianae
Gymnosporangium nelsonii
Gymnosporangium nidus-avis
Monilinia fructicola
Phyllosticta ampelicida

Pithoascus intermedius
Pleiochaeta setosa
Puccinia subnitens
Sphaerotheca macularis
Venturia inaequalis
Venturia pirina

glumes

Stagonospora nodorum

greenhouse

Peziza proteana

hair (human)

Piedraia hortae

hardwood trees

Exidia recisa
Sporidesmium foliculatum
Sporidesmium hormiscioides
?Tricholoma fulvum

hay

Fusarium sporotrichioides var. sporotrichioides

house dust

Mariannaea elegans

insect frass

Typhula thaxteri

insects

Paecilomyces breviramosus
Paecilomyces farinosus
Paecilomyces tenuipes

lawns and fields

Agaricus semotus

leaves, needles

Atopospora betulina
Botryosphaeria rhodorae
Calyptella capula
Cercospora avicularis
Cercospora handelii
Cercosporella virgaureae
Coleroa chaetomium
Coniella pulchella
Didymella applanata
Didymella bryoniae
Fabraea cincta
Flammulaster rhombosporus
Gymnosporangium betheli
Gymnosporangium clavariiforme
Gymnosporangium clavipes
Gymnosporangium connersii
Gymnosporangium cornutum
Gymnosporangium fuscum
Gymnosporangium gaeumannii ssp. albertense
Gymnosporangium globosum
Gymnosporangium juniperi-virginianae
Gymnosporangium nelsonii
Gymnosporangium nidus-avis
Gymnosporangium tremelloides
Hormotheca plantaginis
Hormotheca robertiani
Hormotheca rubicola
Leptotrochila ranunculi
Lophodermium maculare
Lophodermium melaleucum
Lophodermium sphaerioides
Marasmiellus paludosus
Marasmius salalis
Marssonina brunnea
Marssonina castagnei
Marssonina populi
Melampsora hirculi
Melanotus caricicola
Metacoleroa dickiei
Microthyrium macrosporum
Monilinia fructicola
Mycena cariciophila
Nyssopsora clavellosa
Peziza phyllogena
Peziza varia
Phragmidium arcticum
Phragmidium fusiforme var. noviboreale
Phragmidium occidentale
Phragmidium potentillae
Phyllosticta acicola
Phyllosticta ampelicida
Phyllosticta celastrina
Phyllosticta gaultheriae
Phyllosticta hamamelidis
Phyllosticta minima
Phyllosticta multicorniculata
Phyllosticta pallidior
Phyllosticta pervincae
Phyllosticta pyrolae

Phyllosticta sphaeropsoidea
Phyllosticta thujae
Phyllosticta toxica
Phyllosticta yuccae
Pileolaria brevipes
Pleiochaeta setosa
Psathyrella typhae
Pseudopeziza singularis
Pseudoseptoria bromigena
Pseudoseptoria stomaticola
Psilachnum cassandrae
Psilocybe bulbosa
Puccinia anemones-virginianae
Puccinia araliae
Puccinia areolata
Puccinia arnicalis
Puccinia balsamorhizae
Puccinia gibberulosa
Puccinia calthae
Puccinia calthicola
Puccinia campanulae
Puccinia canadensis
Puccinia codyi
Puccinia conglomerata
Puccinia coronata var. avenae
Puccinia dayi
Puccinia distichlidis
Puccinia fergussonii
Puccinia gemella
Puccinia gentianae
Puccinia gigantispora
Puccinia glacieri
Puccinia haleniae
Puccinia helianthi
Puccinia holboellii
Puccinia hordei
Puccinia intermixta
Puccinia iridis
Puccinia karelica spp. karelica
Puccinia karelica spp. laurentina
Puccinia leveillei
Puccinia limosae
Puccinia lobeliae
Puccinia longipes
Puccinia malvacearum
Puccinia ornatula
Puccinia ortonii
Puccinia parnassiae
Puccinia physalidis
Puccinia podophylli
Puccinia pulsatillae
Puccinia recondita
Puccinia schedonnardi
Puccinia sherardiana
Puccinia silphii
Puccinia sorghi
Puccinia striiformis
Puccinia subnitens
Puccinia trautvetteriae
Puccinia treleasiana
Puccinia triticina
Puccinia tumidipes
Puccinia urbanis
Puccinia ustalis
Puccinia violae ssp. americana
Puccinia volkartiana
Puccinia xanthii
Ramularia coalescens
Roestelia brucensis
Septoria bromi
Septoria elymi
Septoria passerinii
Septoria tritici
Sowerbyella imperialis
Sphaerotheca macularis
Stagonospora avenae
Stagonospora nodorum
Stemphylium sarciniforme
Uredo beringiana
Uromyces acuminatus
Uromyces eugentianae
Uromyces geranii
Uromyces lapponicus var. lapponicus
Uromyces lapponicus var. oxytropis
Uromyces phacae-frigidae
Uromyces polygoni-avicularis
Uromyces punctatus
Venturia adusta
Venturia asperata
Venturia canadensis
Venturia chlorospora
Venturia inaequalis
Venturia minuta
Venturia pirina
Venturia rumicis
Venturia saliciperda
Venturia subcutanea
Xenodochus carbonarius

lichen woodlands

Cortinarius calopus

old perithecia
Typhula thaxteri

peat bogs
Hohenbuehelia longipes
Omphalina brevibasidiata

Picea forest
Hygrophorus hyacinthinus

plywood
Connersia rilstonii

reptile eggs
Cephaliophora tropica

resupinate Basidiomycetes (fungi)
Endophragmiella verticillata

rhizosphere
Glomus aggregatum
Glomus constrictum
Glomus mosseae
Sclerocystis rubiformis

roots
Colletotrichum coccodes
Coniella pulchella
Dendryphion nanum
Gaeumannomyces graminis var. tritici
Lagena radicicola
Marasmius epidryas
Olpidium brassicae
Peziza phyllogena
Polymyxa betae
Polymyxa graminis
Rhizina undulata
Sclerocystis rubiformis

seeds and kernels
Coniella pulchella
Eurotium echinulatum
Fusarium poae
Fusarium sporotrichioides var. sporotrichioides
Microascus longirostris
Paecilomyces variotii
Petriella sordida
Pithoascus intermedius
Pleiochaeta setosa
Stemphylium sarciniforme
Trichurus spiralis

sepals
Melampsora hirculi
Venturia inaequalis

shoots
Venturia saliciperda

softwood pulp chips
Bactrodesmium moenitum

soil, sand
Caloscypha fulgens
Cantharellula umbonata
Dendryphion nanum
Discina leucoxantha
Discina macrospora
Glomus aggregatum
Glomus constrictum
Glomus mosseae
Gyromitra infula
Hygrocybe spadicea
Inocybe dulcamara
Laccaria maritima
Mariannaea elegans
Paecilomyces carneus
Paecilomyces farinosus
Paecilomyces fumosoroseus
Paecilomyces inflatus
Paecilomyces lilacinus
Paecilomyces marquandii
Paecilomyces variotii
Peziza proteana
Peziza varia
Pseudobaeospora pillodii
Rhizina undulata
Sclerocystis rubiformis
Tylopilus rubrobrunneus

stabilized sand dunes
Cortinarius calopus
Cystoderma lilacipes
Laccaria maritima

stem galls
Cucurbitaria staphula
Gymnosporangium betheli
Gymnosporangium connersii
Gymnosporangium globosum
Gymnosporangium juniperi-virginianae
Gymnosporangium nelsonii
Gymnosporangium tremelloides
Roestelia brucensis

stems
Calyptella capula
Colletotrichum coccodes
Dendryphion comosum
Dendryphion nanum
Didymella applanata
Didymella bryoniae
Didymella delphinii
Gaeumannomyces graminis var. tritici
Marasmius epidryas
Melanotus caricicola
Papulaspora sepedonioides
Petriella sordida
Phyllosticta celastrina
Pileolaria brevipes
Pseudoseptoria bromigena
Pseudoseptoria stomaticola
Puccinia araliae
Puccinia gibberulosa
Puccinia campanulae
Puccinia haleniae
Puccinia holboellii
Puccinia malvacearum
Puccinia parnassiae
Puccinia podophylli
Puccinia sherardiana
Puccinia silphii
Puccinia subnitens
Roestelia brucensis
Scopinella solani
Sphaerotheca macularis
Stagonospora avenae
Stigmina dothideoides
Taeniolella exilis
Uromyces polygoni-avicularis
Venturia adusta
Venturia canadensis

stumps
Discina korfii
Discina macrospora

tubers
Helminthosporium solani
Papulaspora sepedonioides

turf
Fusarium sporotrichioides var. sporotrichioides

twigs and branches
Bactrodesmium traversianum
Capnobotrys neesii
Capnobotrys sessilispora
Dendryphion comosum
Diaporthe alleghaniensis
Diatrype albopruinosa
Diatrype virescens
Dibotryon morbosum
Endophragmiella subolivacea
Endophragmiella uniseptata
Endoxylina allantospora
Eutryblidiella sabina
Gymnosporangium betheli
Gymnosporangium clavariiforme
Gymnosporangium clavipes
Gymnosporangium connersii
Gymnosporangium fuscum
Gymnosporangium globosum
Gymnosporangium inconspicuum
Gymnosporangium juniperi-virginianae
Gymnosporangium nelsonii
Gymnosporangium nidus-avis
Gymnosporangium tremelloides
Lophodermium melaleucum
Marasmiellus paludosus
Marasmiellus papillatus
Marasmius salalis
Massaria inquinans
Massaria lantanae
Massaria zanthoxyli
Monilinia fructicola
Petriella sordida
Peziza varia
Phaeomarasmius erinaceus
Phragmocephala elliptica
Pseudomassaria corni
Psilocybe bulbosa
Roestelia brucensis
Sclerotinia kerneri

Sowerbyella imperialis
Steganosporium acerinum
Taeniolella alta
Taeniolella exilis
Therrya fuckelii
Typhula thaxteri
Tyromyces kmetii
Venturia inaequalis
Venturia pirina
Venturia saliciperda

willow catkins

Flammulaster rhombosporus

witches' broom

Apiosporina collinsii
Gymnosporangium nidus-avis

wood

Acrophragmis canadensis
Amylocorticium canadense
Amylocorticium cebennense
Amylocorticium subincarnatum
Athelopsis glaucina
Bactrodesmium biformatum
Bactrodesmium moenitum
Bactrodesmium obovatum
Bactrodesmium spilomeum
Brachysporium abietinum
Brachysporium nigrum
Brachysporium noblesiae
Brachysporium obovatum
Brachysporium pendulisporum
Caloscypha fulgens
Chlorencoelia versiformis
Cordana inaequalis
Cordana pauciseptata
Dactylosporium macropus
Diplococcium clarkii
Discina korfii
Discina macrospora
Endogone pisiformis
Endophragmiella angustispora
Endophragmiella biseptata
Endophragmiella collapsa
Endophragmiella globulosa
Endophragmiella ontariensis
Endophragmiella pallescens
Endophragmiella verticillata
Eutryblidiella sabina
Gyromitra infula
Helicogloea farinacea
Helicoma morgani
Helminthosporium velutinum
Hyphoderma sibiricum
Marasmiellus papillatus
Mariannaea elegans
Neobulgaria pura
Oedocephalum cristallinum
Paecilomyces farinosus
Paecilomyces variotii
Petriella sordida
Peziza phyllogena
Peziza proteana
Peziza varia
Phragmocephala elliptica
Phragmocephala stemphylioides
  var. stemphylioides
Pseudospiropes nodosus
Pseudospiropes simplex
Rhizina undulata
Schizophyllum commune
Spadicoides atra
Spadicoides bina
Spadicoides canadensis
Spadicoides grovei
Spadicoides klotzschii
Spadicoides obovata
Sporidesmium brachypus
Sporidesmium foliculatum
Sporidesmium hormiscioides
Sporidesmium larvatum
Taeniolella alta
Taeniolella rudis
Typhula thaxteri

woody debris

Peziza proteana
Rhizina undulata
Typhula thaxteri

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ENDOGONE AURANTIACA, A NEW SPECIES IN THE ENDOGONALES FROM POLAND

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Abstract

A new species of the genus *Endogone, E. aurantiaca*, forming zygosporangia enveloped individually by a hyphal mantle and occurring in loose aggregates or singly in the soil is described and illustrated. Zygosporangia of *E. aurantiaca* are deep orange, globose to subglobose, (110–)139(–180) μm diam, sometimes ovoid or ellipsoidal, 120–150 x 140–180 μm, and have a wall ornamented with evenly distributed conical warts. The zygospore wall of this fungus is smooth, hyaline, and somewhat thicker than that of a zygosporangium. *Endogone aurantiaca* was present among roots of *Pinus sylvestris* growing in different regions of Poland.

Key words: Endogonales, *Endogone aurantiaca*, new species, occurrence, Poland

Introduction

Examination of soil samples taken from the root zone of plants colonizing sand dunes of Poland revealed an undescribed species of the genus *Endogone*. This fungus is described in this paper as *E. aurantiaca sp. nov.*

Materials and methods

Roots and attached soil of sample plants were collected from a depth of 5–30 cm and subsequently refrigerated at 4 C until processing. Trap pot cultures were established based on the original soils placed in 15–cm plastic pots (1350 cm^3) and seeded with *Pinus sylvestris* L. Plants were grown in a greenhouse at 18–40 C with 16 h photoperiod (combined incandescent and cool white fluorescent light) and watered 2–3 times a week. Pot cultures were harvested after 12 months, roots stained with 0.05% trypan blue (Phillips and Hayman, 1970), and examined for the presence of mycorrhizae.

To extract spores, both field–collected soils and those from pot cultures were wet sieved and decanted (Gerdemann and Nicolson, 1963). Two sieves with openings of 40 and 250 µm diam were used. No newly formed spores were found in trap cultures. Therefore, only field–collected spores were further investigated. At least 100 and 20 spores were mounted in polyvinyl alcohol/lactic acid/glycerol, PVLG (Koske and Tessier, 1983) and Melzer's reagent, respectively, and examined. Specimens for scanning electron microscopy examination were first fixed in 3% glutaraldehyde in a 0.02 M phosphate buffer (pH 6). They were then dehydrated in a graded ethanol series, critical point dried, mounted on aluminium stubs, and coated with gold. The terminology used follows that of Pegler et al. (1993). Specimen color was examined under a dissecting microscope on fresh specimens immersed in water. Color names are from Kornerup and Wanscher (1983). Specimens have been preserved on slides mounted in PVLG and deposited in the Department of

Plant Pathology (DPP), Academy of Agriculture, Szczecin, Poland, and in the herbarium at Oregon State University (OSC), USA. Nomenclature of fungi noted here follows Walker and Trappe (1993). The classification is that of Morton and Benny (1990).

Descriptions and discussions

Endogone aurantiaca Błaszkowski, sp. nov.

Figs. 1–6

Zygosporangiae laxae gregaria vel singulatim in solo efformatae. Gregaria ovoideae; 160–270 x 250–500 µm; e zygosporangis 2–4 in tunica hypharum. Peridium absens. Tunica (4.9–)16.0(–32.5) µm crassa, e hyphis sinuatis, hyalinis vel aurantiaco–albis, (2.5–7.9(–10.0) µm diam. Zygosporangiae intense aurantiacae; globosae vel subglobosae; (100–)139(–180) µm diam; aliguando ovoideae vel late ellipsoideae; 130–180 µm. Tunica zygosporangiae solitaria, intense aurantiaca, (0.8–)1.4(–2.0) µm crassa, cum conicis verrucis, 0.4–0.7 µm latis ad basam, 0.4–0.7 µm altis. Tunica zygosporae solitaria, glabra, hyalina, (1.0–)2.0(–2.9) µm crassa. Gametangia pallide luteae vel intense aurantiacae; subglobosae, ellipsoideae vel irregulare; (20.0–)21.7(–31.0) µm latae, (17.5–)30.0(–43.0) µm longae; tunica gametangium glabra, 1.8–3.9 µm crassa.

HOLOTYPUS. Poland. Kampinos National Park, infra *Pinus sylvestris* L., 26 July 1986, *Błaszkowski, J.*, *900* (DPP).

Zygosporangia occurring in loose aggregates or singly in the soil (Figs. 1, 2).

Aggregates ovoid; 160–270 x 250–500 µm; composed of 2–4 loosely and randomly positioned zygosporangia enveloped individually by hyphal mantle.

Peridium absent.

Mantle (4.9–)16.0(–32.5) µm thick; consisting of interwoven, sinuous, hyaline to orange white (5A2) hyphae, (2.5–)7.9(–10.0) µm diam (Figs. 1–4); mantle hyphae adherent to zygosporangia more compactly interwoven and darker colored than those positioned in the outer region of the mantle; hyphae of the outer mantle layer branched and interwoven with those of neighboring zygosporangia.

Zygosporangia deep orange (6A8); globose to subglobose; (100–)139(–180) µm diam (Figs. 1, 2); sometimes ovoid or broadly ellipsoidal; 120–150 x 140–180 µm; with a circular pore, 7.5–12.5 µm diam, at the junction of the larger of the two gametangia.

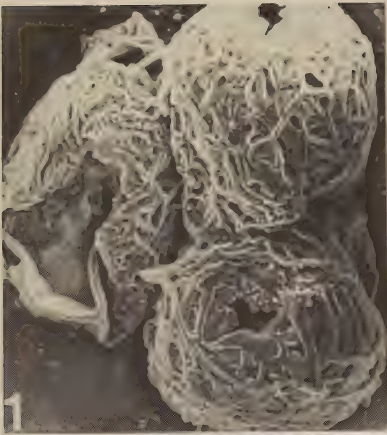
Zygosporangial wall consisting of a single layer, deep orange (6A8), (0.8–)1.4(–2.0) µm thick, ornamented with evenly distributed conical warts, 0.4–0.7 µm wide at the base, 0.4–0.7 µm high (Figs. 3–5).

Zygospore wall single, smooth, hyaline, (1.0–)2.0(–2.9) µm thick, usually tightly adherent to the zygosporangial wall (Fig. 5).

Gametangia pastel yellow (3A4) to deep orange (5A8); subglobose, ellipsoidal, prolate or irregular; (20.0–)21.7(–31.0) µm wide, (17.5–)30.0(–43.0) µm long, of unequal size, placed one near another (Fig. 6), rarely absent; gametangial wall smooth, 1.8–3.9 µm thick at the zygosporangial base; wall of the larger gametangium continuous with the zygosporangial wall; gametangia usually covered by hyphal mantle of zygosporangia.

Zygospore contents of hyaline lipid globules.

Figs. 1–6. *Endogone aurantiaca*. **1**. Aggregate with three zygosporangia. Scanning electron microscopy (SEM), x264. **2.** Zygosporangium enveloped by hyphal mantle. SEM, x528. **3.** Sinuous hyphae of mantle and warts (arrows) of zygosporangial wall. SEM, x1056. **4.** Hyphae of mantle (HM) and warty zygosporangial wall. Differential interference contrast (DIC), x927. **5.** Zygosporangial wall (ZSW) and zygospore wall (ZW). Phase contrast microscopy (PCM), x1309. **6.** Gametangia (G). PCM, x1309.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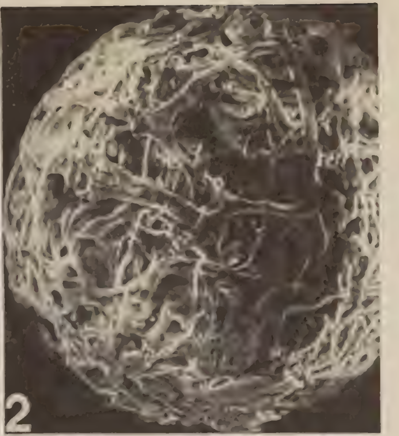
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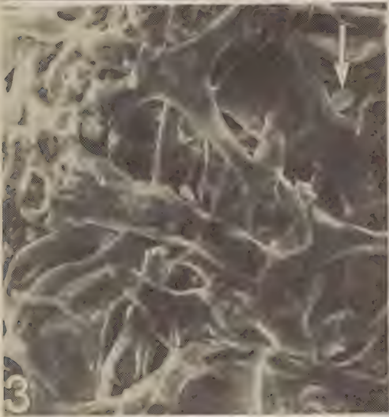
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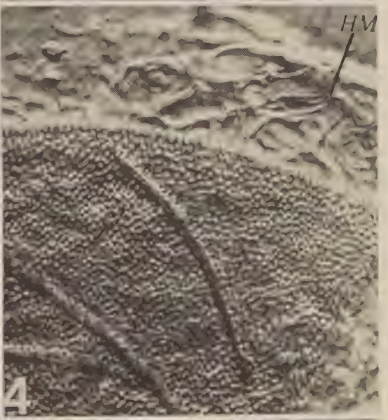
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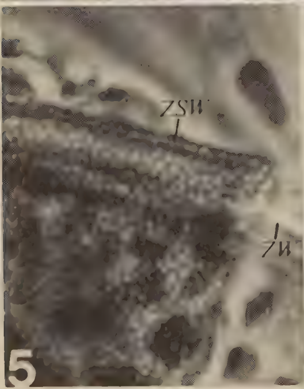
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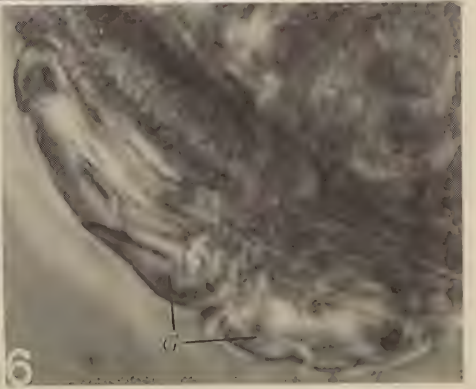
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Zygosporangia, zygospores, gametangia, and hyphal mantle not reacting in Melzer's reagent.

COLLECTION EXAMINED. HOLOTYPE. POLAND. Kampinos National Park (52°18'N, 20°46'E), under *Pinus sylvestris* L., 26 July 1986, *Błaszkowski, J., 900* (DPP); Isotypes: *Błaszkowski, J., 899, 901–907, 1016–1019, 1374–1379* (DPP) and two slides at OSC.

OTHER MATERIALS EXAMINED. POLAND. All unnumbered collections made by J. Błaszkowski, under *P. sylvestris*, Hel Peninsula, 29 July 1986; Żelistrzewo (Gdańsk voiv.), 22 Aug. 1987; Płoty (Szczecin voiv.), 22 Sept. 1987; Bydgoszcz, 15 Sept. 1987 (DPP).

ETYMOLOGY. Latin, *aurantiaca*, referring to the deep orange color of zygosporangia.

DISTRIBUTION AND HABITAT. Of the almost 800 soil samples representing ca 90 plant species in 28 families, zygosporangia of *E. aurantiaca* occurred only in those taken from the root zone of *P. sylvestris*. The zygosporangia density in 100 g dry soil ranged from 1 to 132 (av. 27.8) and was highest in the soil sampled from inland sand dunes of the Kampinos National Park. Only this soil sample contained *E. aurantiaca* zygosporangia grouped in aggregates. In the other sites, this fungus formed zygosporangia singly in the soil.

The chemical properties of the soil from the Kampinos National Park were: pH, 5.8; NO_3 (mgL^{-1}), 20; P, 17; and K, 20.

The fungi accompanying *E. aurantiaca* in the soil samples examined were *Acaulospora lacunosa* Morton, *Glomus deserticola* Trappe, Bloss & Menge, *Scutellospora dipurpurescens* Morton & Koske, and *Complexipes moniliformis* Walker emend. Yang & Korf. *Complexipes moniliformis* is known to form ecto– or ectendomycorrhizae with *P. sylvestris* (Wilcox et al., 1983), whereas the other species are arbuscular fungi (Morton, 1986;

Morton and Koske, 1988; Trappe et al., 1984) and were probably associated with mycorrhizal roots of neighboring grasses.

MYCORRHIZAL ASSOCIATIONS. *Endogone aurantiaca* occurred in the field among ectomycorrhizal roots of *P. sylvestris* and those with vesicular–arbuscular infections coming from adjacent grasses. This fungus failed to form new zygosporangia and mycorrhizae in pot cultures with *P. sylvestris.*

Endogone aurantiaca is distinctive due to the formation of zygosporangia in loose aggregates or singly in the soil and especially by its ornamented zygosporangial wall. The characteristic feature of this species also is the lack of a peridium. All species of the genus *Endogone* described so far produce more or less compact sporocarps (Gerdemann and Trappe, 1974; Morton and Benny, 1990; Pegler et al., 1993; Tandy, 1975).

The zygosporangia occurring both in aggregates and singly in the soil are individually surrounded by a hyphal mantle. In the zone adherent to the zygosporangial wall, this mantle consists of tightly interwoven hyphae forming a dense sheath easily separating from the zygosporangium. This sheath differentiates more loosely interwoven hyphae. In the outer zone of the mantle, the hyphae frequently branch and interweave with those of the mantle of neighboring zygosporangia, uniting them in aggregates. Most of the *E. aurantiaca* specimens recovered possess zygosporangia enclosed by a hyphal mantle. Some specimens have such a mantle present only on a part of a zygosporangium, especially that adjacent to gametangia. The outer surface of these zygosporangia is covered with a hyaline to yellowish white (2A2) layer, usually continuous with the innermost layer of the hyphal mantle. The surface of this layer is smooth to granular. A similar layer is usually present in specimens lacking a hyphal mantle at all. Additionally, this layer extends along the gametangia. This suggests this layer to be an initial stage of the hyphal mantle differentiation.

The deep orange zygosporangial wall of all the specimens examined is evenly covered with conical warts. It always is thinner and more flexible than the hyaline and readily cracking zygospore wall. Due to the rigidity of the zygospore wall causing its tight adherence to the zygosporangial wall, the presence of a zygospore in mature specimens is frequently difficult to reveal.

Almost all the specimens examined by the author of this paper possess two adherent gametangia. One of them is usually larger and adheres to a pore in the zygosporangial wall. The gametangial wall is continuous with the zygosporangial wall. These gametangia are usually covered with hyphae of the mantle surrounding zygosporangia.

Species of the genus *Endogone* forming zygosporangia resembling in color and size those of *E. aurantiaca* are *E. alba* (Petch) Gerd. & Trappe, *E. flammicorona* Trappe & Gerd., and *E. lactiflua* Berk. & Broome (Gerdemann and Trappe, 1974; Pegler et al., 1993; Yao et al., 1992). However, these species produce compact sporocarps surrounded by a peridium (vs. loose aggregates without a peridium or single zygosporangia in *E. aurantiaca*). The zygosporangia of *E. aurantiaca*, *E. flammicorona*, and *E. lactiflua* are enclosed by a hyphal mantle that is absent in *E. alba*. The hyphal mantle of *E. aurantiaca* is formed by interwoven sinuous hyphae. *Endogone flammicorona* also has a mantle with a spiral, sinuous pattern when observed in a plan view (Gerdemann and Trappe, 1974). However, in a cross–sectional view, this mantle resembles a crown or „tongues of flame" produced by hyphal ridges wider at the base and thinner at the top, being, thereby, unlike the mantle of *E. aurantiaca* consisting of 2–6 layers of interwoven hyphae.

The hyphal mantle of *E. lactiflua* is reminiscent of the *E. aurantiaca* mantle in a cross–sectional view, although it is not spirally arranged as in the latter species when observed in a plan view.

The most distinctive feature of *E. aurantiaca* is its ornamented zygosporangial wall. Except for *E. alba*, the other described species of this genus form smooth–walled zygosporangia (Gerdemann and Trappe, 1974; Pegler et al., 1993; Tandy, 1975). The zygosporangial wall of *E. alba* has a minutely rugulose to almost reticulate ornamentation, frequently with branching ridges (Yao et al., 1992), whereas that of *E. aurantiaca* is covered with conical warts.

Additionally, the features separating *E. aurantiaca* from the species listed above are the lack of reactivity in Melzer's reagent (vs. zygosporangial wall yellow to pale orange and reddish brown in *E. flammicorona* and *E. lactiflua*, respectively), the hyaline zygospore wall (vs. melon yellow, hyaline to light yellow, and yellow in *E. alba*, *E. flammicorona*, and *E. lactiflua*, respectively), and the relatively narrow gametangia (20–31 µm wide vs. up to 36 µm, up to 40 µm, and up to 80 µm wide in *E. alba*, *E. flammicorona*, and *E. lactiflua*, respectively).

Apart from *E. aurantiaca*, known fungal species of this genus producing sporocarps lacking a peridium include *E. acrogena* Gerd., Trappe & Hosford and *E. verrucosa* Gerd. & Trappe (Gerdemann and Trappe, 1974). *Endogone aurantiaca* differs in that it has no zygosporangia arranged either in chains as in *E. acrogena* or in clusters enclosed in an endoperidium as in *E. verrucosa*. Additionally, the zygosporangia of the latter two fungi are much smaller than those of the former new species.

The formation of single zygosporangia in the soil by fungi of the genus *Endogone* is revealed for the first time in this paper, although non–sporocarpic zygosporangia of *E. flammicorona* and *E. lactiflua* had earlier been recovered (Błaszkowski, 1989; Błaszkowski, unpubl.). The method commonly used in collecting fungi of *Endogone* is raking and searching through the leaf litter and the upper layer of soil (Gerdemann and Trappe, 1974; Pegler et al., 1993). However, this method reveals only relatively large sporocarps. Direct searching of the soils containing *E. aurantiaca* did not reveal such sporocarps. Wet sieving and decanting of soils by sieves used in the study discussed here recovers spores and sporocarps larger than 40 µm diam. Hence, the properties of sporocarps of this new species are probably correctly defined in this paper. Additionally, the occurrence of single zygosporangia of this fungus as well as those of *E. flammicorona* and *E. lactiflua* (Błaszkowski, 1989; Błaszkowski, unpubl.) in the soil suggest that other species of the genus *Endogone* also are both sporocarpic and non–sporocarpic.

Acknowledgment

I would like to thank Dr. J. H. Warcup, Department of Plant Pathology, Waite Agricultural Research Institute, University of Adelaide, South Australia, and Dr. T. W. K. Young, Division of Life Sciences, King's College, University of London, U. K. for valuable comments on the manuscript. This study was supported in part by The Committee of Scientific Researches, a grant no. 6.P205.043.05.

Literature cited

Błaszkowski, J. 1989. The occurrence and geographic distribution of E–strain ectendomycorrhizal fungi in Poland. *Bull. Pol. Ac. Biol.* 37, 19–31.

Gerdemann, J. W., and T. H. Nicolson. 1963. Spores of mycorrhizal *Endogone* species extracted from soil by wet sieving and decanting. *Trans. Br. Mycol. Soc.* 46, 235–244.

Gerdemann, J. W., and J. M. Trappe. 1974. The Endogonaceae in the Pacific Northwest. *Mycologia Mem.* 5, 1–76.

Koske, R. E., and B. Tessier. 1983. A convenient, permanent slide mounting medium. *Newsl. Mycol. Soc. Am.* 34, 59.

Kornerup, A., and J. H. Wanscher. 1983. *Methuen handbook of colour.* 3rd Ed. E. Methuen and Co., Ltd., London. 252 pp.

Morton, J. B. 1986. Three new species of *Acaulospora* (Endogonaceae) from high aluminium, low pH soils in West Virginia. *Mycologia* 78, 641–648.

Morton, J. B., and G. L. Benny. 1990. Revised classification of arbuscular mycorrhizal fungi (Zygomycetes): a new order, Glomales, two new suborders, Glomineae and Gigasporineae, and two new families, Acaulosporaceae and Gigasporaceae, with an emendation of Glomaceae. *Mycotaxon* 37, 471–491.

Morton J. B., and R. E. Koske. 1988. *Scutellospora dipurpurascens*, a new species in the Endogonaceae from West Virginia. *Mycologia* 80, 520–524.

Pegler, D. N., B. M. Spooner, and T. W. K. Young. 1993. *British truffles. A revision of British hypogeous fungi.* Royal Botanic Gardens, Kew. 216 pp. + 26 plates.

Phillips, J. M., and D. S. Hayman. 1970. Improved procedures for clearing roots and staining parasitic and vesicular–arbuscular mycorrhizal fungi for rapid assessment of infection. *Trans. Br. Mycol. Soc.* 55, 158–161.

Tandy, P. A. 1975. Sporocarpic species of Endogonaceae in Australia. *Aust. J. Bot.* 23, 849–866.

Trappe, J. W., E. Bloss, and J. Menge. 1984. *Glomus deserticola* sp. nov. *Mycotaxon* 20, 123–127.

Walker, C., and J. M. Trappe. 1993. Names and epithets in the Glomales and Endogonales. *Mycol. Res.* 97, 339–344.

Wilcox, H. E., C. S. Yang, and K. LoBuglio. 1983. Responses of pine to E–strain ectendomycorrhizal fungi. *Plant and Soil* 71, 239–247.

Yao, Y. –J., D. N. Pegler, and T. W. K. Young. 1992. Revision of the type of *Endogone alba* (Endogonaceae). *Mycotaxon* 45, 109–122.

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HETEROTOLYPOSPORIUM, A NEW GENUS OF USTILAGINALES.*

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ABSTRACT

A new genus, *Heterotolyposporium* K. Vánky is described and illustrated together with its type *H. lepidospermae* K. Vánky, sp. nov., on *Lepidosperma ensiforme* (Rodway) D. I. Morris (Cyperaceae), from Tasmania, Australia. A second species, *H. piluliforme* (Berkeley) K. Vánky, comb. nov., is also presented, based on *Uredo piluliformis* Berk., type on *Juncus* sp. (Juncaceae).

INTRODUCTION

While studying smut fungi collected in Tasmania, I came across two species which cannot be included in any known genus of Ustilaginales (comp. Vánky, 1987). One of these is known under the name of *Sorosporium piluliforme* (Berk.) McAlpine, on various *Juncus* species. The other, collected on a *Lepidosperma* (Cyperaceae) is a new species. Both have in common the grey colour of the dry, powdery mass of spores due to a mixture of dark-coloured spore balls and colourless, small, single spores. Both kinds of spores germinate giving rise to phragmobasidia.

MATERIALS AND METHODS

Smutted plants were collected in Tasmania, Australia, pressed and dried. Material used for studies of the sorus structure, spore morphology and spore germination was taken from these specimens, preserved in the author's herbarium (Herb. Ustil. Vánky, HUV) and in the Tasmanian Herbarium, University of Tasmania, Hobart (HO).

For light microscopical (LM) studies, dried spores were rehydrated in lactophenol by gently heating to boiling point. For scanning electron microscopical (SEM) studies, dried spores were dusted on double-sided adhesive tape, mounted on specimen stub, sputter-coated with gold-palladium, ca. 20 nm, and examined in a SEM at 10 kV.

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For the study of germination, spores were spread thinly on water agar (WA) and on malt yeast peptone agar (MYP), in Petri dishes, kept at room temperature (ca. 22 °C). As soon as basidiospores were produced, a suitable piece of medium (about 10 mm square) was cut out, transferred to a slide, and covered with a coverglass. A small droplet of lactophenol with cotton blue, added to the side of the square of medium, fixed and stained the basidia and basidiospores. If germination of the coloured spores needed a longer time, the easily germinating hyaline spores were killed by treating the spore mixture with a 0.01% solution of Amisept (di-isobutyl phenoxyethoxyetyldimethyl-ammonium chloride, used by Kukkonen & Hyytiäninen (1969) for disinfecting of *Anthracoidea* spores, and by Vánky & Bauer (1992) for killing conidia of *Conidiosporomyces*) for one hour, then the spore mixture was washed with distilled water twice for 10 minutes followed by centrifugation.

RESULTS

The combination of the characters of the studied two species of smut fungi are so unique and peculiar that a new genus is necessary to accommodate them.

Heterotolyposporium K. Vánky, **gen. nov.**

Sori in organis differentibus plantarum matricalium massam nudam sporarum e sporis duo generum compositam: e sporis crasse tunicatis, pigmentiferis, in glomerulis agglutinatis vel etiam solitariis et e sporis solitariis, non coloratis, tenuiter tunicatis, inter glomerulos dispersis. Glomeruli sporarum eiusdem generis tantum compositi. Peridium nullum, columella nulla, cellulae steriles inter glomerulos sporarum et sporas nullae. Germinatio sporarum utriusque generis phragmobasidium efficiens. Typus generis *H. lepidospermae* K. Vánky.

Sori in different organs of the host plants producing naked spore masses composed of two kinds of spores: thick-walled, pigmented spores, agglutinated in spore balls or single, and single, colourless, thin-walled spores dispersed between the spore balls. Spore balls composed of the same type of spores only. No peridium, no columella, no sterile cells between the spore balls and spores. Germination of both kinds of spores results in phragmobasidia.

Heterotolyposporium lepidospermae K. Vánky, **sp. nov.**

Typus in matrice *Lepidosperma ensiforme* (Rodway) D. I. Morris (*L. elatius* Labill. var. *ensiforme* Rodway; Cyperaceae; det. D. I. Morris, HO), Australia, Tasmania, North Coast, 10 km E. urbe Launceston, 41°27' S 147°14' E, alt. cca. 30 m, 15.III.1996, leg. C. & K. Vánky. Holotypus in HO, isotypi in Herbario Ustil. Vánky (HUV 17818), in BPI et in Vánky, Ustilagineles exsiccata No. 957.

Sori (Fig. 1) in omnibus floribus eiusdem paniculi, glumis perfecte obtecti, flores mixtura cinerea usque cinereo-nigra glomerulorum sporarum obscurum et mulitudinis sporarum hyalinorum (propter hoc color cinereus massae sporarum in statu sicco) implentes, cca. 1,5 x 2–2,5 mm. Massa sporarum vicem organorum omnium centralium florae – exceptis glumis 3–4 maxime externis – implens pulverea, apice agglutinata, acuta, parte basali rotundta. Glomeruli sporarum (Figg. 4, 5) atro-rufobrunnei, ovoidei, elongati, plerumque irregulares, satis permanentes, e sporis pigmentiferis 2–25 (vel pluribus?, plerumque 2–10) compositi, 15–35(–40) x 18–40(–50) µm; vel sporae singlares. Sporae (Figg. 4, 5) rufo- usque atro-rufobrunneae, forma variae, irregulares, subpolyedricae, vel elongatae, lateribus contingentibus deplanatae, semiglobosae vel semiovoideae, 6,5–15 x 12–20 µm; pariete levi, variabiliter incrassato, (0,5–)1–4(–5) µm crasso, in angulis crassissimo. Sporae non pigmentiferae (Figg. 4, 5) copiose inter glomerulos sporarum singillatim vel in catervis, sed glomerulos non formantes, distributae, globosae usque late ellipsoidales, magnitudine variabiles, 4–8 x 5–10 µm, hyalinae usque valde pallide flavidae; pariete cca. 1 µm crasso, in luce transeunti sub microscopio subtiliter, lineam externam sporae non afficienter punctato, in SEM dense, irregulariter verrucoso. Germinatio sporarum pigmentiferarum (Fig. 2; in agaro aquoso, temperatura conclavis, post 1 diem) basidia 2–4-cellularia, 2–3 x 15–50 µm efficiens. In basidiis, in sterigmatibus, lateraliter et terminaliter basidiosporae ovoideae, elongate ellipsoidales usque subfusiformes, 1–1,5(–2) x 6–15(–20) µm, productae. In basidiis etiam hyphae, serius septatae et ramificatae, productae. Germinatio sporarum non pigmentiferarum (Fig. 2) conditionibus identicis, basidia et basidiosporas similes sed plerumque minores, basidia saepe 2-cellularia tantum, efficiens.

Sori (Fig. 1) in all flowers of a panicle, completely hidden by the glumes, filling the flowers with a grey to greyish-black mixture of dark spore balls and numerous small, hyaline spores (hence the grey colour of the spore mass when dry), sori ca. 1.5 x 2–2.5 mm. The spore mass is replacing all central floral organs except the outermost 3–4 glumes; it is powdery except for the agglutinated, pointed top and rounded basal part. Spore balls (Figs. 4, 5) dark reddish-brown, ovoid, elongated, usually irregular, rather permanent, composed of 2–25 (or more?, mostly 2–10) pigmented spores, 15–35(–40) x 18–40(–50) µm, or spores single. Spores (Figs. 4, 5) reddish- to dark reddish-brown, variable in form, irregular, subpolyhedral or elongated, with flattened contact sides, hemiglobose or hemiovoid, 6.5–15 x 12–20 µm; wall smooth, of variable thickness (0.5–)1–4(–5) µm, thickest at the angles. Unpigmented spores (Figs. 4, 5) between the spore balls numerous, single or in groups but not forming balls, globose to broadly ellipsoidal, variable in size, 4–8 x 5–10 µm, hyaline to very pale yellow; wall ca. 1 µm thick, in LM finely punctate which does not affect the spore profile, in SEM densely, irregularly verrucose. Germination of the pigmented spores (Fig. 2; on WA, at room temp., after one day) results in 2–4-celled basidia measuring 2–3 x 15–50 µm. On the basidia, on sterigmata, lateral and terminal, ovoid, long ellipsoidal to subfusiform basidiospores are produced measuring 1–1.5(–2) x 6–15(–20) µm. On the basidia hyphae are also produced which later become septate and ramified. Germination of the colourless spores (Fig. 2), under the same conditions, results also in similar basidia and basidiospores but they are usually smaller, the basidia often only 2-celled.

In a squashed piece from the basal part of the sorus, stained with cotton blue in lactophenol, abundant intra- and intercellular hyphae and young, hyaline spores were observed between spore balls of different developmental stages. Coiled groups of sporogenous hyphae did not precede the formation of spore balls, as it does in several spore ball forming genera of Ustilaginales (e. g. *Moesziomyces, Sorosporium, Sporisorium, Thecaphora*).

1

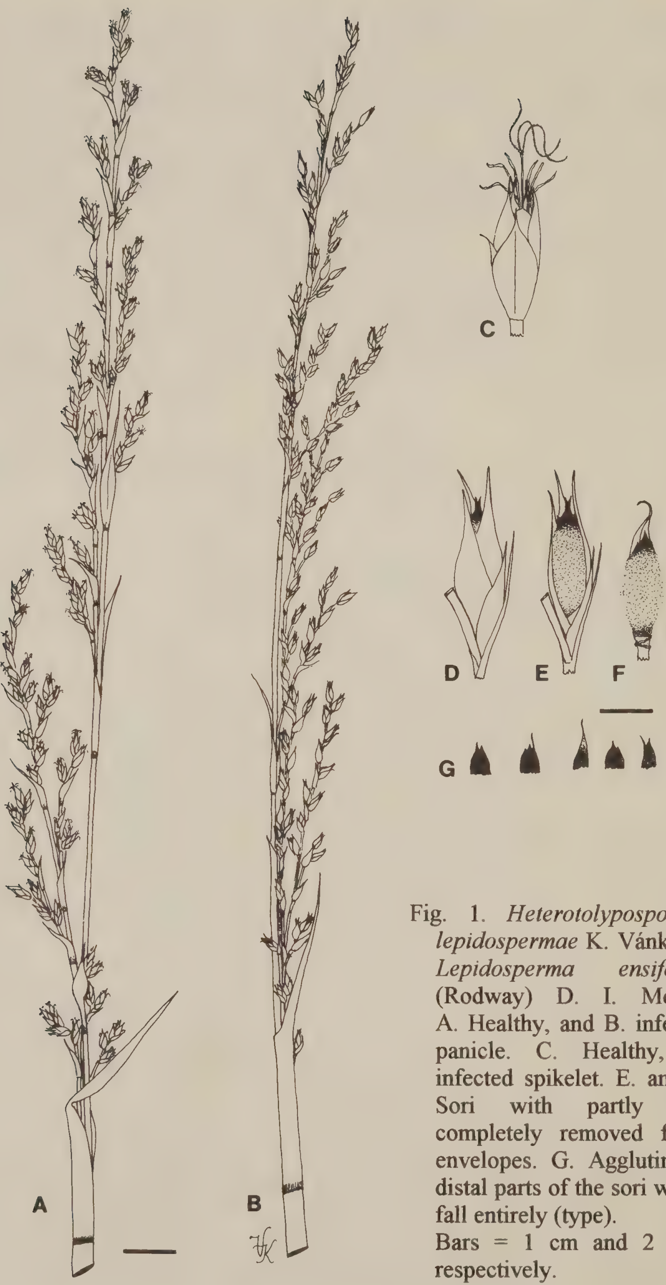


Fig. 1. *Heterotolyposporium lepidospermae* K. Vánky on *Lepidosperma ensiforme* (Rodway) D. I. Morris. A. Healthy, and B. infected panicle. C. Healthy, D. infected spikelet. E. and F. Sori with partly and completely removed floral envelopes. G. Agglutinated distal parts of the sori which fall entirely (type).

Bars = 1 cm and 2 mm, respectively.

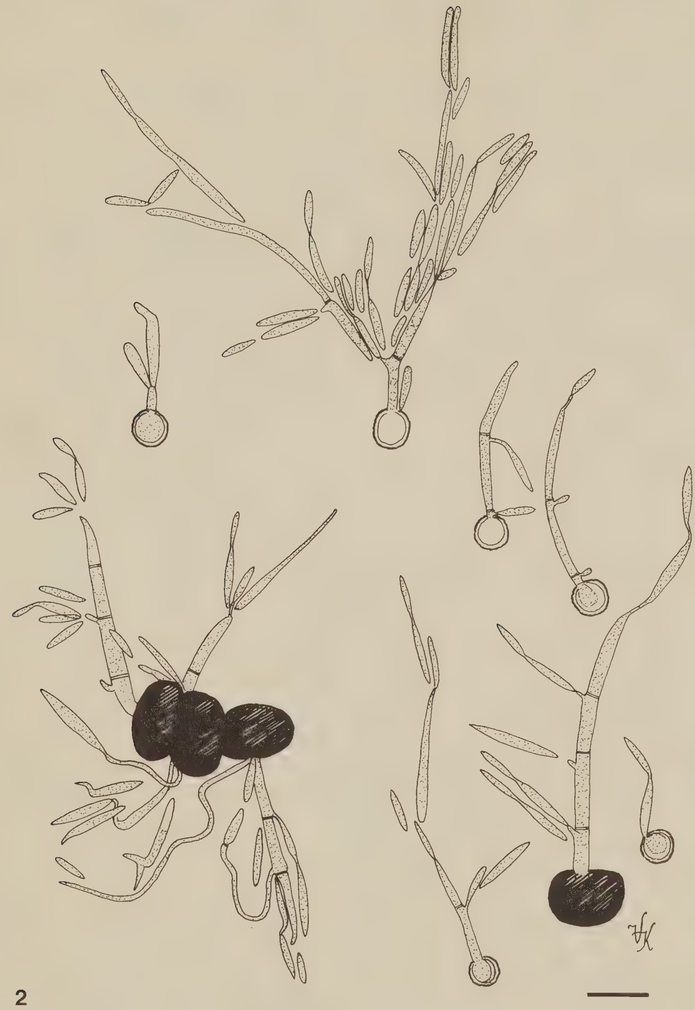


Fig. 2. Germinating pigmented and colourless spores of *Heterotolyposporium lepidospermae* K. Vánky with 2–4-celled basidia on which, on sterigmata, ovoid, long ellipsoidal to subfusiform basidiospores are produced (type; on WA, at room temp., after 1–2 days). Bar = 10 µm

The dark, agglutinated, pointed top of the sori (Fig. 1 G) is easily detaching and falling from the powdery mass of spore mixture beneath.

Infection must be systemic (all flowers of a panicle contain sori). The way of infection is not known.

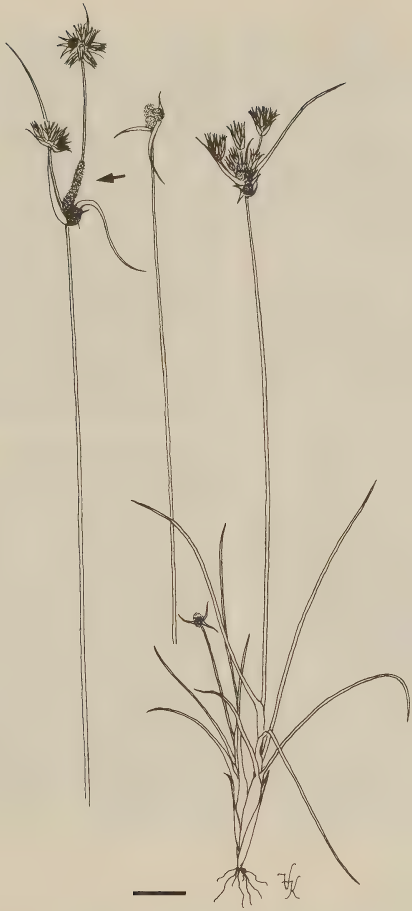
On Cyperaceae: *Lepidosperma ensiforme* (Rodway) D. I. Morris. Known only from Australia, Tasmania, from the type collection.

A further species belonging to this new genus is:

Heterotolyposporium piluliforme (Berkeley) K. Vánky, **comb. nov.**
Basionym: *Uredo piluliformis* Berkeley (as "*pilulaeformis*"), London J. Bot. 2:523 (as "423"), 1843. – *Ustilago piluliformis* (Berk.) L.-R. & C. Tulasne, 1847:93. – *Cintractia piluliformis* (Berk.) P. Hennings, 1898:293. – *Sorosporium piluliforme* (Berk.) McAlpine, 1910:180 (as "*piluliformis*"). – Type on *Juncus* sp., Republic of South Africa, Uitenhage, December, coll. Zeyher (89).

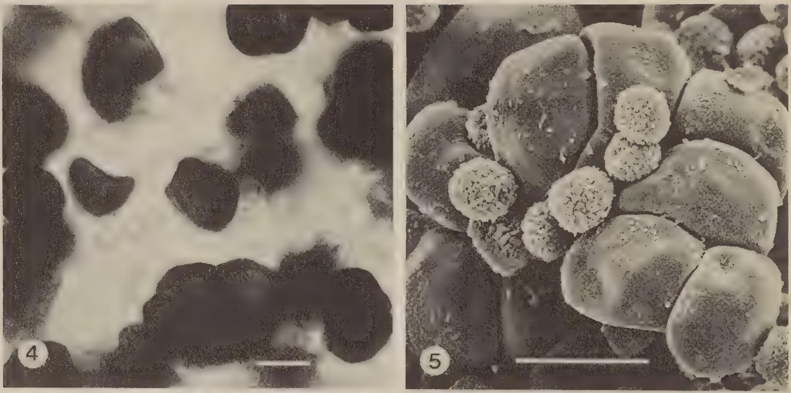
Ustilago muelleriana Thümen, in Thümen, Mycotheca universalis No. 623, 1877; 1878:444. – *Cintractia muelleriana* (Thümen) Ciferri, 1931:72. – Type on *Juncus planifolius* R. Br., Australia, Victoria, River Loddon, summer 1875, coll. F. v. Mueller. Isotypes in Thümen, Mycoth. univ. No. 623 (HUV 1698!).

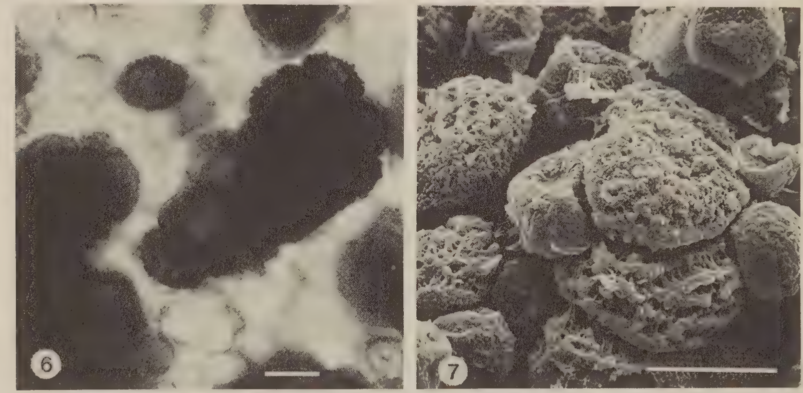
Sori (Fig. 3) naked, globoid or elongated, comprising the basal part of the capsule or more commonly the whole capsule and all central floral organs, not rarely also including the basal part of the perianth segments or the whole flower. In the inflorescence one or several, more rarely all flowers may be destroyed and transformed into globoid, ovoid or lobed bodies of 1–2 mm or up to 3 mm by confluence, rather compact with a powdery surface, grey or greyish-black due to the mixture of dark spore balls and hyaline, single spores. Sori rarely also around the basal part of a branch in the inflorescence, in this case elongated (5–10 mm). Dark spores agglutinated in balls or single. Spore balls (Figs. 6, 7) rather permanent, subglobose, ovoid, irregular or elongated, 15–30 x 20–50 µm, dark reddish-brown to opaque, composed of 2–10(–15) spores. Spores (Figs. 6, 7) subglobose, ellipsoidal, hemiglobose, usually irregular with flattened contact sides, 8–15 x 12–20 µm, dark reddish-brown; wall uneven, 1–3 µm wide, thickest at the angles and on the free surface; contact sides smooth, free surface irregularly, incompletely, densely verrucose-reticulate. Colourless spores (Figs. 6, 7) globose, subglobose, ovoid to ellipsoidal, variable in size, 6.5–11 x 6.5–15 µm; globose spores 6.5–11 µm in diameter, hyaline; wall even, 0.5–1 µm thick, in LM smooth in SEM rough, due to low warts. Four months old colourless spores germinated easily (Fig. 8; at room temp., after 1–2 days). On water agar shorter, 1-celled, or longer, septate basidia developed producing ovoid or subcylindrical basidiospores and hyphae. On MYP (Fig. 9) septate basidia were produced on which abundant basidiospores, hyphae and septate, basidium-like structures developed. Germination of the pigmented spores (Fig. 10; treated with Amisept, kept on WA for one month, transferred to MYP, at room temp., after 3 days; Dr. R. Bauer) resulted in 3–7-celled basidia measuring 3–4 x 50–70 µm. Basidial cells often copulate in pairs and develop small, ovoid to large, subcylindrical basidiospores measuring 2–2.5 x 4–8 to 3.5–6 x 15–35 µm, and also slender, septate, ramifying hyphae.



3

Fig. 3. Sori of *Heterotolyposporium piluliforme* (Berk.) K. Vánky in the flowers, rarely around the basal part of a branch in the inflorescence (arrow) of *Juncus caespitosus* E. Mey. (Vánky, Ust. exs. No. 840). Bar = 1 cm.





Figs. 4, 5. Pigmented spores, balls of pigmented spores and small, colourless spores of *Heterotolyposporium lepidospermae* K. Vánky on *Lepidosperma ensiforme* (Rodway) D. I. Morris in LM and in SEM (type).

Figs. 6, 7. Pigmented spores, balls of pigmented spores and small, colourless spores of *Heterotolyposporium piluliforme* (Berk.) K. Vánky on *Juncus planifolius* R. Br., Australia, Tasmania, West Coast, near Strahan, 12.III.1996, coll. C. & K. Vánky (HUV 17648, Vánky, Ust. exs. No. 958). Bars = 10 μm

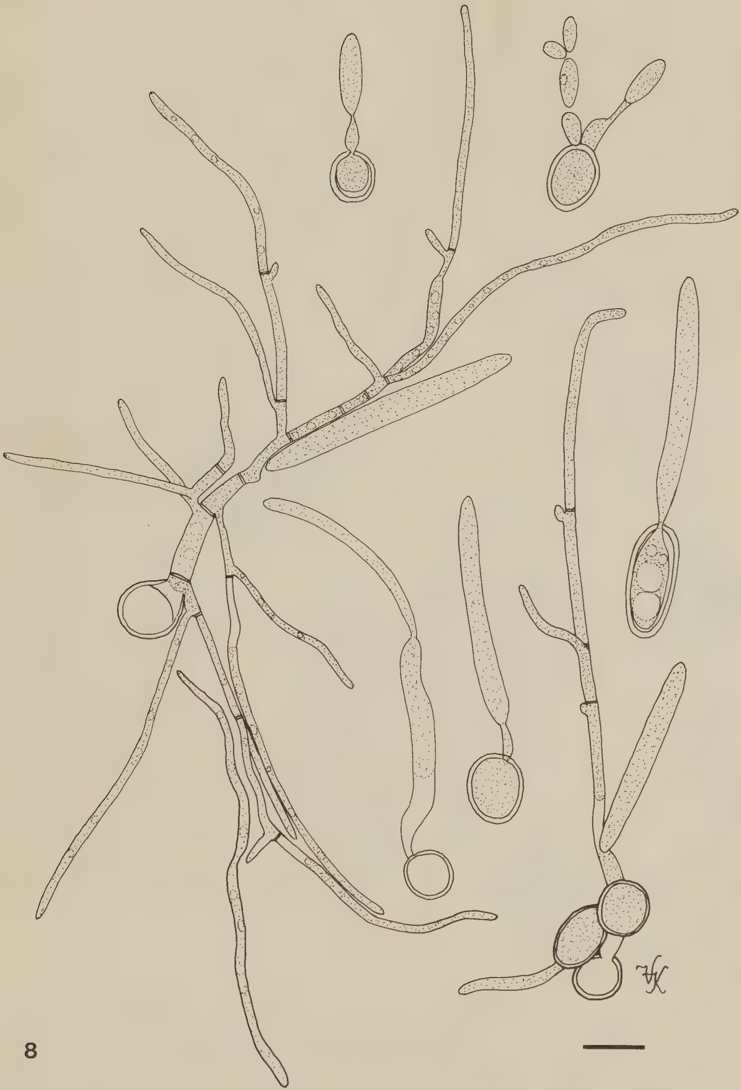


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Fig. 8. Germinating colourless spores of *Heterotolyposporium piluliforme* (Berk.) K. Vánky on *Juncus planifolius* R. Br. (on WA, at room temp., after 1–2 days), with 1–4-celled basidia on which large, subcylindrical basidiospores and ramified, septate hyphae are produced (HUV 17648). Bar = 10 µm

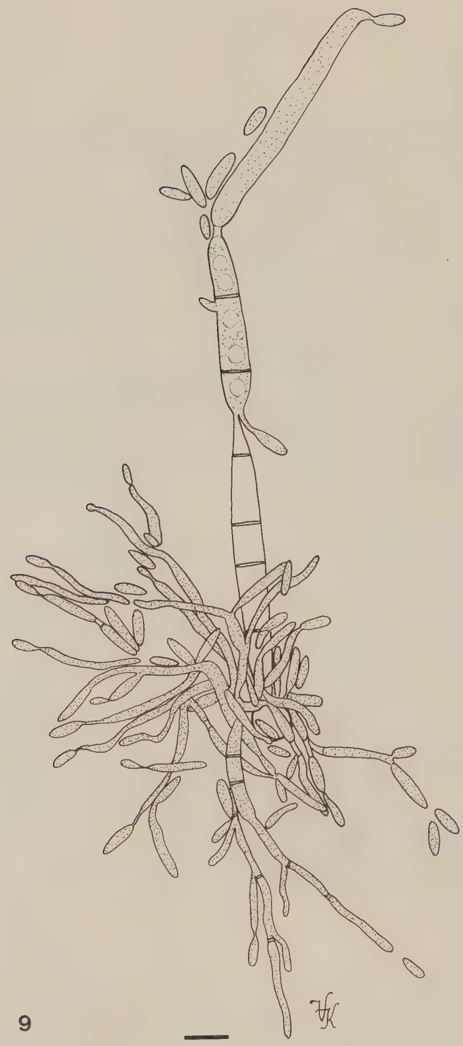

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Fig. 9. A germinating colourless spore of *Heterotolyposporium piluliforme* (Berk.) K. Vánky on *Juncus planifolius* R. Br. (on MYP). On a septate basidium (already empty) abundant basidiospores and hyphae, and also basidium-like structures are produced (HUV 17648). Bar = 10 µm

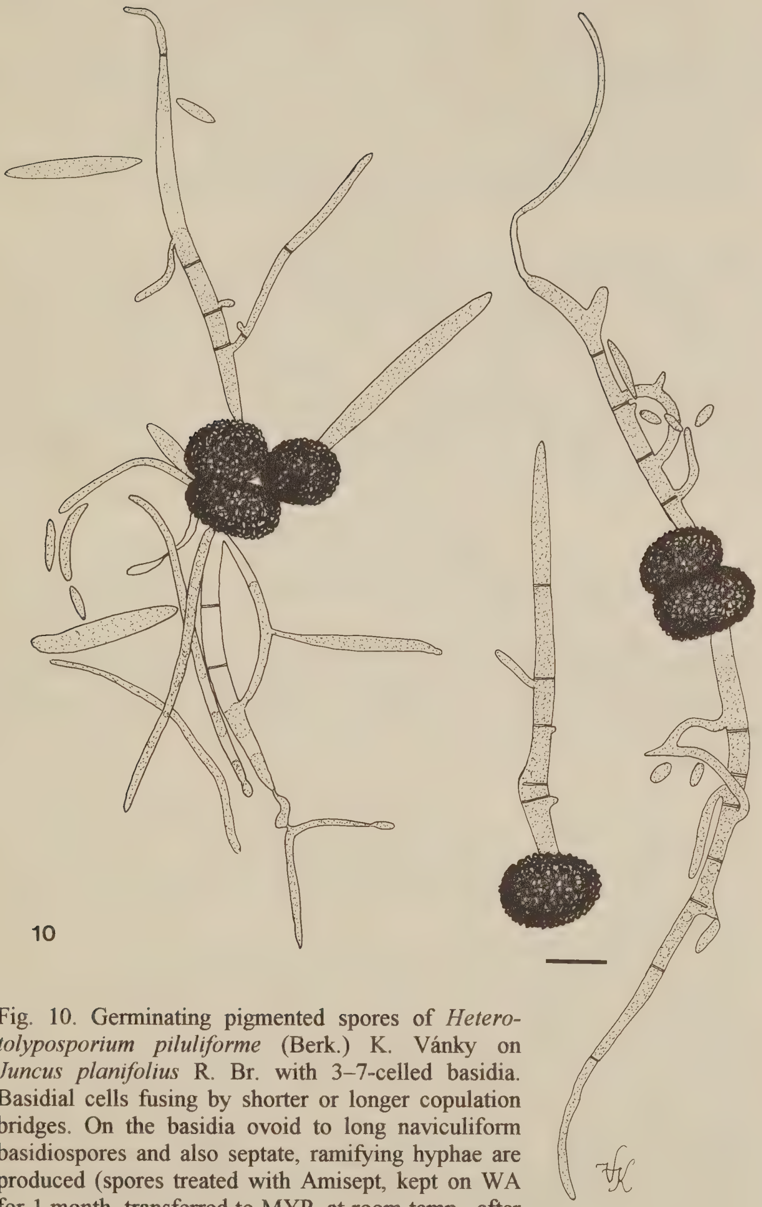

Fig. 10. Germinating pigmented spores of *Heterotolyposporium piluliforme* (Berk.) K. Vánky on *Juncus planifolius* R. Br. with 3–7-celled basidia. Basidial cells fusing by shorter or longer copulation bridges. On the basidia ovoid to long naviculiform basidiospores and also septate, ramifying hyphae are produced (spores treated with Amisept, kept on WA for 1 month, transferred to MYP, at room temp., after 3 days; HUV 17648). Bar = 10 µm

Development of spore balls and colourless spores was observed in the central, basal part of the sori where these differentiated within abundant fascicles of hyphae. The spore balls are developing like those of *Tolyposporium junci*, not from coiled sporogenous hyphae, as is typical for several spore ball forming genera of Ustilaginales. Mixed with spore balls of different stages of maturation, numerous young, globoid, hyaline spores were observed.

On Juncaceae: *Juncus caespitosus* E. Mey., *J. capensis* Thünb., and *J. planifolius* R. Br., South Africa, South Australia and New Zealand.

DISCUSSION

Heterotolyposporium is the sole genus of Ustilaginales possessing a mixture of two different kinds of spores within the same sorus, both germinating more or less similar. In *Conidiosporomyces* K. Vánky (type *C. ayresii* (Berk.) K. Vánky on *Panicum maximum* Jacq.) between the single, pigmented, thick-walled spores, groups of hyaline, thin-walled, Y-shaped conidia are present (comp. Vánky & Bauer, 1992). The sorus localisation and appearance in *Heterotolyposporium piluliforme* is rather similar to that of *Tolyposporium junci* (Schröter) Woronin (type on *Juncus bufonius* L.). In this species, however, only dark-coloured spore balls are present.

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LITERATURE CITED

Berkeley, M. J. 1843. Enumeration of fungi, collected by Herr Zeyher in Uitenhage. – London J. Bot. 2:507-527 + Pl. XII.

Ciferri, R. 1931. Quinta contribuzione allo studio degli Ustilaginales. – Ann. Mycol. 29:1-74.

Hennings, P. 1898. Fungi austro-africani II. – Hedwigia 37:293-295.

Kukkonen, I. & Hyytiäinen, R. 1969. A method for sterilizing spores of *Anthracoidea* (Ustilaginales) and the effect of sterilization on spore germination. – Ann. Bot. Fenn. 6:243-254.

McAlpine, D. 1910. The smuts of Australia, etc. – Melbourne, 285 pp.

Thümen von, F. 1878. Symbolae ad floram mycologicam Australiae. II. – Flora 61:440-444.

Tulasne, L.-R. & C. 1847. Mémoire sur les Ustilaginées comparées aux Urédinées. – Ann Sci. Nat. Bot., Sér. 3, 7:12-127.

Vánky, K. 1987. Illustrated genera of smut fungi. – Cryptogamic Studies 1:1-159 (ed. W. Jülich). Gustav Fischer Verlag, Stuttgart/New York.

--- & Bauer, R. 1992. *Conidiosporomyces*, a new genus of Ustilaginales. – Mycotaxon 43:426-435.

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TROPICAL HYPHOMYCETES OF MEXICO I. NEW SPECIES OF *HEMICORYNESPORA*, *PIRICAUDA* AND *RHINOCLADIUM*

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ABSTRACT

Three new species of dematiaceous hyphomycetes are described and illustrated: *Hemicorynespora rostrata*, *Piricauda mexicana* and *Rhinocladium mexicanum*. They were collected in tropical and semitropical areas from Mexico. Related species and distribution of the genera are discussed.

Key words: Hyphomycetes, *Piricauda*, *Hemicorynespora*, *Rhinocladium*, tropical fungi, Mexico,Veracruz.

INTRODUCTION

This contribution is the first of a series that the authors are preparing, in order to increase the knowledge of the mexican hyphomycetes. Tropical areas are a major source of biodiversity; about 20% of mexican territory is composed of tropical and semitropical areas (Rzedowski, 1988). Knowledge of saprotrophic micromycetes in natural ecosystems remains underdeveloped in Mexico. Given the accelerated deforestation of tropical habitats, the task of a fungal inventory represents a challenge for taxonomic mycologists. During the past five years periodic surveys have been carried out in tropical forests of the states of Veracruz and Campeche in order to collect conidial fungi from plant litter. Some new and interesting tropical hyphomycetes from Mexico have already been described by Heredia (1994), Mercado-Sierra and Heredia (1994), Heredia *et al*. (1995), Mercado-Sierra *et al*. (1995) and Mena-Portales *et al*. (1995).

In this present study all the material was studied *in situ*, and from preparations in lactophenol or in polyvinyl alcohol. Specimens are deposited in the Herbarium of the Instituto de Ecología (XAL).

SPECIES DESCRIPTION

Hemicorynespora rostrata Mercado, Heredia et Mena sp. nov. Figs.1 & 2a-b.

Coloniae effusae, breve velutinae, brunneae. **Mycelium** plerumque in substrato immersum, ex hyphis septatis, ramosis, brunneis, laevibus, 1.5-2.5 µm diam. compositum. **Conidiophora** macronemata, mononemata, erecta, recta, non ramosa, cylindrica vel lageniformia, laevia, 1-6 septata, 51-102 µm longa, 3.5-4.5 µm crassa. **Cellulae conidiogenae** monotreticae, terminales, integratae, percurrentes, 12-21 x 3-5 µm. **Conidia** acrogena, sicca, solitaria, laevia, naviculiformia vel obclaviformia, rostrata, infra medium 1-septata, cellula basalis breve et pallidae brunneis, cellula apicalis brunneis ad apicem pallidioribus, 20-28 x 4-8 µm, cicatrice basali 3-5 µm lata, apice 5-10 µm longa, 1-1.5 µm lata.

Holotypus: CON 266-1 (XAL). G. Heredia. 20/V/1994.

Colonies effuse, slightly velvety, brown. **Mycelium** mostly immersed on the substratum, composed of branched, septate, brown, smooth walled hyphae, 1.5-2.5 µm thick. **Conidiophores** macronematous, mononematous, erect, straight, unbranched, cylindrical, smooth walled, brown to dark brown, 1-6-septate, 51-102 µm long and 3.5-4.5 µm wide. **Conidiogenous cells** monotretic, terminal, integrated, percurrent, 12-21 x 3-5 µm. **Conidia** dry, acrogenous,

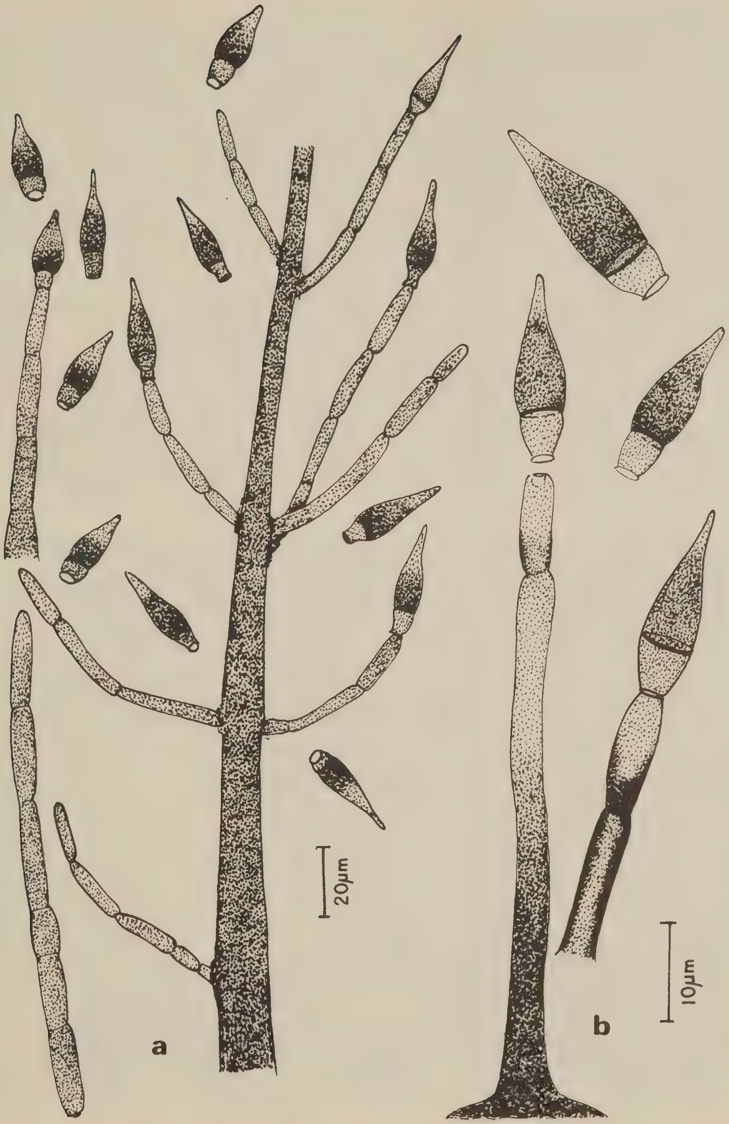

Fig. 1. *Hemicorynespora rostrata* sp. nov. **a**. Conidiophores growing over an undetermined conidiophore. **b**. Conidiophore, conidiogenous cells and conidia.

solitary, smooth walled, navicular or obclavate, rostrate, with a single transverse septum situated below the conidium center, the basal cell is short and pale brown, the apical cell is darker, with the apex rostrate and pale, 20-28 x 4-8 µm, basal scar 3-5 µm wide, apex rostrate 5-10 x 1-1.5 µm.
Holotype: CON 266-1 (XAL). G. Heredia. 20/V/1994.
Habitat: Tropical rain forest. The Tropical Biology Station "Los Tuxtlas", Veracruz. On rotten wood, growing on undetermined conidiophores.

At present the genus *Hemicorynespora* M. B. Ellis comprises four species; *H. deightonii* M. B. Ellis, collected on dead branches of *Bersama paullinioides* from Sierra Leone (Ellis, 1972); *H. mitrata* (Penz. and Sacc.) M. B. Ellis on rotting monocotyledon leaves from Java (Ellis, 1972) and on dead leaf-sheath of *Musa sapientum* from Taiwan (Matsushima ,1987); *H. aseptata* Hol.-Jech., growing on dead rachis and petiole of palm-trees from Cuba (Holubová-Jechová, 1987), and *H. naviculiformis* Matsushima on dead leaves of *Pandani* sp. from Micronesia (Matsushima, 1981).

H. rostrata has certain features in common with *H. naviculiformis*, which has conidia navicular, l-septate, concolorous and 18-30 x 6-7.5 µm. However, the new species differs from this and other species, by posessing rostrate, l-septate, conidia, with the basal cell paler than the apical. Furthermore, conidia of *H. rostrata* are narrower (4-7 µm) than those of *H. naviculiformis* (6-7.5µm).

Piricauda mexicana Mercado, Heredia et Mena sp. nov.
Figs. 2c & 3.

Coloniae effusae, parvae, atrobrunneae, granulosae. **Mycelium** superficiale ex hyphis pallide brunneis, septatis, laevibus compositum. **Conidiophora** micronemata, mononemata, ramosa, varie flexuosa, brunnea, laevia, 2.5-4 µm crassa. **Cellulae conidiogenae** monotreticae, in conidiophora incorporatae,

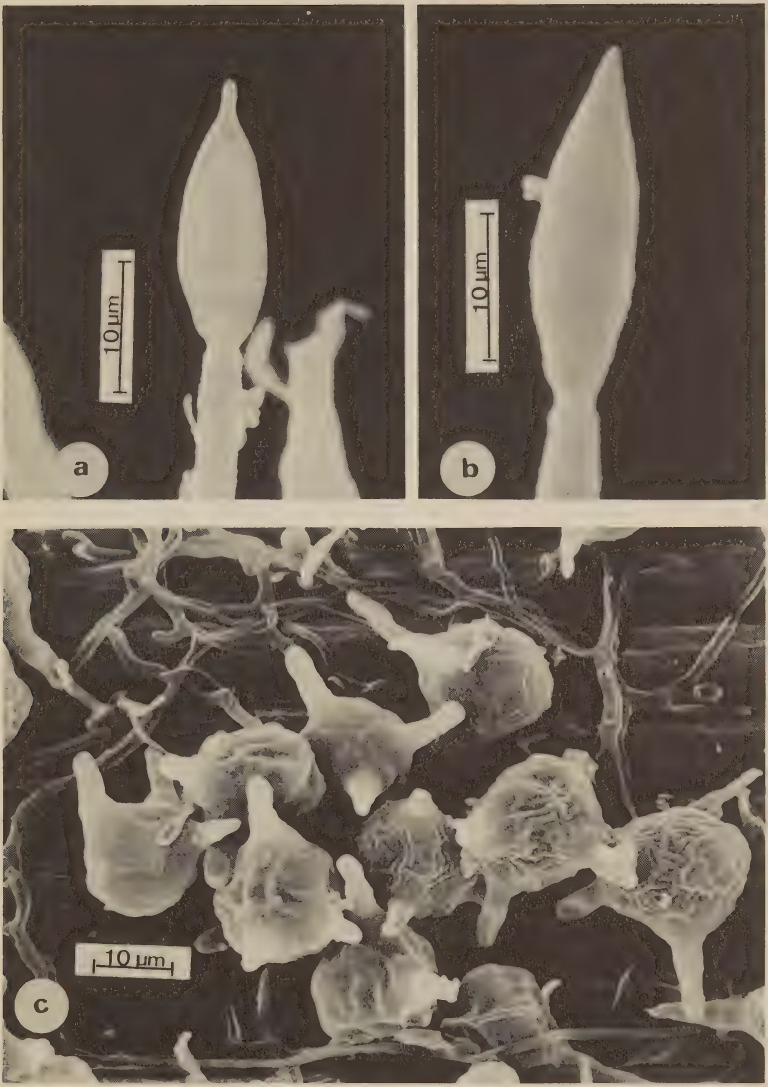

Fig. 2. *Hemicorynespora rostrata* sp. nov. **a-b**. Conidia obclavate with rostrate apex. *Piricauda mexicana* sp. nov. **c**. Mycelium over rotten wood and conidia with appendages.

cicatricatae. **Conidia** solitaria, sicca, forma valde variabili, subsphaerica, ovoidea, obovoidea, turbinata, obconica, ellipsoidea vel irregularia, olivaceo brunnea vel brunnea, leviter muriformia ubi matura, parietibus areolatis, 15-23 x 13-22 µm, appendicibus brevibus 2-4, 1-4 septatis, 4-20 x 3-4.5 µm, versus apicem attenuatis.
Holotypus: CON52 (XAL). G. Heredia. 30/VII/1993.

Colonies effuse, small, dark brown, granulose. **Mycelium** superficial composed of pale brown, septate, smooth, hyphae. **Conidiophores** micronematous, mononematous, branched, variously flexuose, brown, septate, smooth walled, 2.5-4 µm thick. **Conidiogenous cells** monotretic, integrated, cicatrized. **Conidia** solitary, dry, subspherical, ovoid, obovoid, turbinate, obconical, ellipsoidal or irregular, olivaceous brown to brown or mid brown, minutely muriform when they are mature, thin-walled, with many vacuoles, 15-23 x 13-22 µm, conidia possess 2-4 short appendages, 1-4 septate, 4-20 x 3- 4.5 µm, slightly attenuate the apex.
Holotype: CON52 (XAL). G. Heredia. 30/VII/1993. **Habitat:** Cloud forest. Jardín Botánico F. J. Clavijero, Xalapa, Ver. On rachis of a palm-tree.

All the species of *Piricauda* Bubák have a tropical distribution. Up to the present the known species are: *P. paraguayensis* (Speg.) R. T. Moore (the type species) collected on leaves of *Bignonia*, *Citharexylum* from Brazil and on *Duranta* leaves from Ecuador and Paraguay (Moore, 1958); *P. cochinensis* (Subram.) M. B. Ellis growing on dead spathes of *Cocos nuciferae* from India (Ellis, 1976); *P. pseudarthriae* (Hansf.) M. B. Ellis over leaves of *Pseudarthria hookeri* from Congo (Ellis, 1976); *P. caribensis* Mercado-Sierra on dead branches of an unidentified tree from Cuba (Holubová-Jechová and Mercado-Sierra, 1984); *P. cubensis* Hol.-Jech. and Mercado- Sierra over dead branches of *Smilax havanensis*from Cuba (Holubová-Jechová and Mercado-Sierra, 1984) and *P. taiwanensis* Matsushima from rotten leaf-rachis of *Arengae engleri*, *Cocos nuciferae* and *Arecastri ramanzoffiani* from Taiwan (Matsushima, 1987).

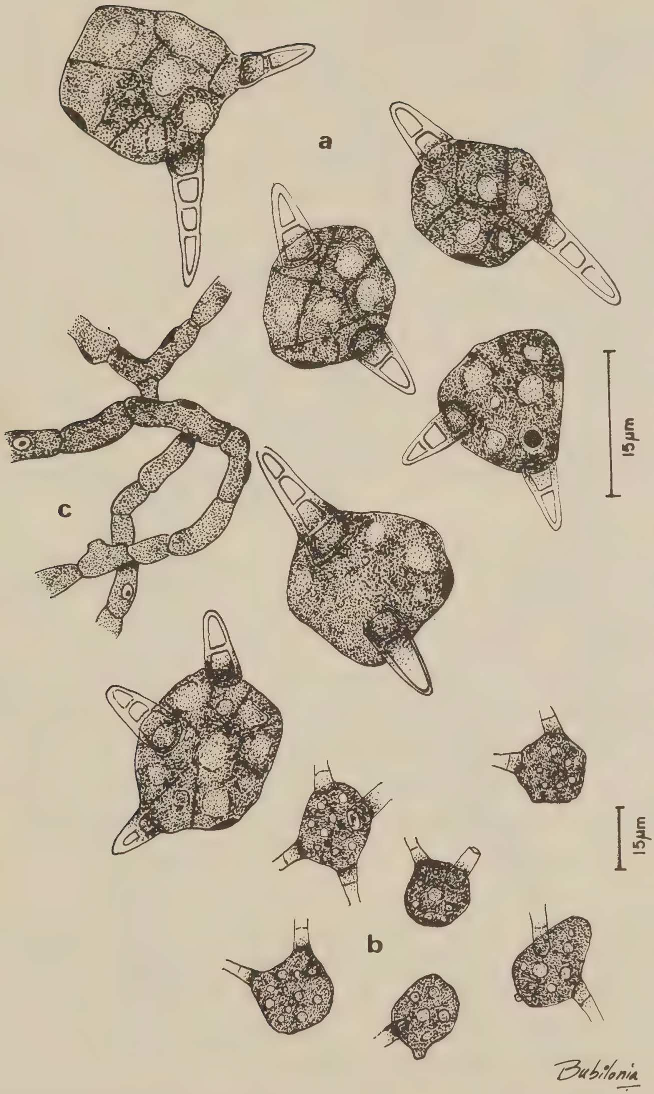
a
c
15µm
15µm
b
Bubilonia

Fig. 3. *Piricauda mexicana* sp. nov. **a**. Mature muriform conidia with appendages and vaculoes. **b**. Inmature conidia. **c**. Monotretic integrated conidiogenous cells.

P. mexicana differs from the above species by the shape and dimensions of its conidia and by the number and size of the conidium appendages. *Piricauda mexicana* resembles to *P. cochinensis*, but conidia in the latter are thick-walled, often verrucose at base, darkly pigmented, without vacuoles and with up to 15 septate appendages.

A taxon which bears some resemblances is *Piricaudilium lobatum* Hol.-Jech. described on dead branches from Cuba (Holubová-Jechová, 1988). Conidia in this species are monotretic, dematiaceous and bear appendages but the body of the conidium is composed of branched narrow hyphae rather than dictyoseptate structure as in *Piricauda mexicana*. Conidia also are larger (30-64 x 32-48 µm) than those of *Piricauda mexicana* (15-23 x 13-19 µm).

Rhinocladium mexicanum Mercado, Heredia et Mena sp.nov.
Figs. 4 & 5.

Coloniae effusae, brunneae, pilosae vel velutinae. **Mycelium** plerumque immersum, partim superficiale. **Conidiophora** plerumque micronemata, ex hyphis irregulariter vel dichotome ramosa, brunnea vel atrobrunnea, septata, laevia, ad 6-8 µm crassa. **Cellulae conidiogenae** polyblasticae, denticulatae plerumque intercalares, denticulis grandibus, conspicuis, cylindricis,truncatis, 1.5-2.5 µm long, 1-2 µm lata. **Conidia** solitaria, sicca, obturbinata vel cordiformia, brunnea, non septata, laevia, 8-13 x 6-9 µm.
Holotypus: C2-1 (XAL). G. Heredia. 20/VI/1994.

Colonies effuse, brown, hairy. **Mycelium** often immersed or partly superficial. **Conidiophores** micronematous, composed of cylindrical crowded dichotomous branches, brown to dark brown, septate, smooth walled, 6-8 µm wide. **Conidiogenous cells** polyblastic, denticulate, mostly intercalary, with large, conspicuous, cylindrical, truncate denticles, 1.5-2.5 µm high and 1-2 µm wide. **Conidia** blastic, solitary, dry, obturbinate or heart-shaped, dark brown, nonseptate, smooth and thick-walled, 8-13 x 6-9 µm.

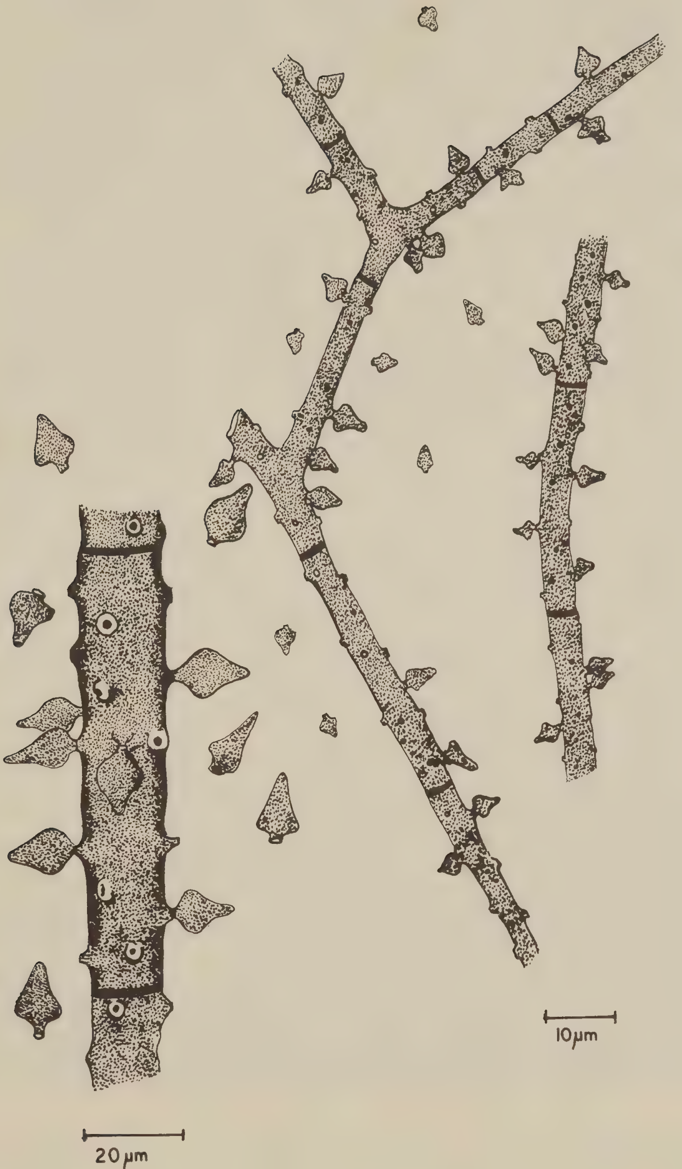

Fig. 4. *Rhinocladium mexicanum* sp. nov.

Holotype: C2-1 (XAL). G. Heredia. 20/VI/1994. **Habitat:** Tropical rain forest. Calakmul Biosphere Reserve, Campeche. On inner surface of rotten wood.

The genus *Rhinocladium* Sacc. and March. is characterized by polyblastic conidiogenous cells integrated on the conidiophores (Furlanetto and Dianese, 1995). Hughes (1980) on his review of *Rhinocladium* accepted four species, since then three species have been added to the genus.

The type species, *R. coprogenum* Sacc. and March. was collected from rabbit dung on Belgicum. The remainder species are lignicolous saprophytic. *R. dingleyae* Hughes on rotten wood of *Laurelia novae-zelandiae* and on decaying branch of *Tetrapathaea tetrandra* from New Zealand (Hughes, 1980) and on decaying bark of *Populus* and rotten wood of *Ulmus americana* from United States (Wang and Sutton, 1982). *R. havanense* Mercado and Castañeda on a dead trunk of an unknown leguminous from Cuba (Mercado and Castañeda, 1987). *R. lignicola* (Sacc.) Hughes on rotten wood from France and on dead branches of *Fagus grandifolia* from United States. *R. pulchrum* Hughes and Holubová-Jechová on decaying wood and bark of *Knightia excelsa* from New Zealand; on *Fagus sylvatica* from Czechoslovakia; on *Carpinus betulus* from Hungary (Hughes, 1980); on *Fagus sylvatica* from England (Kirk, 1986) and on a rotten tree bark from Brazil (Furlanetto and Dianese, 1995).

Recently Furlanetto and Dianese (1995) transfered two species to the genus *Rhinocladium*; *R. abietina* (Peck) Furlanetto and Dianese and *R. mangenotii* (Reisinger) Furlanetto and Dianese. The former was recorded on bark of prostate trunks from U.S. A. and the last on branches of *Rhus cotinus* from France.

R. mexicanum is distinct from all described species of the genus by the peculiar shape of its conidia which are obturbinate or heart-shaped. The species of *Rhinocladium* described up to now possess sphaerical, ovoid, obovoid, pyriform or ellipsoidal conidia.

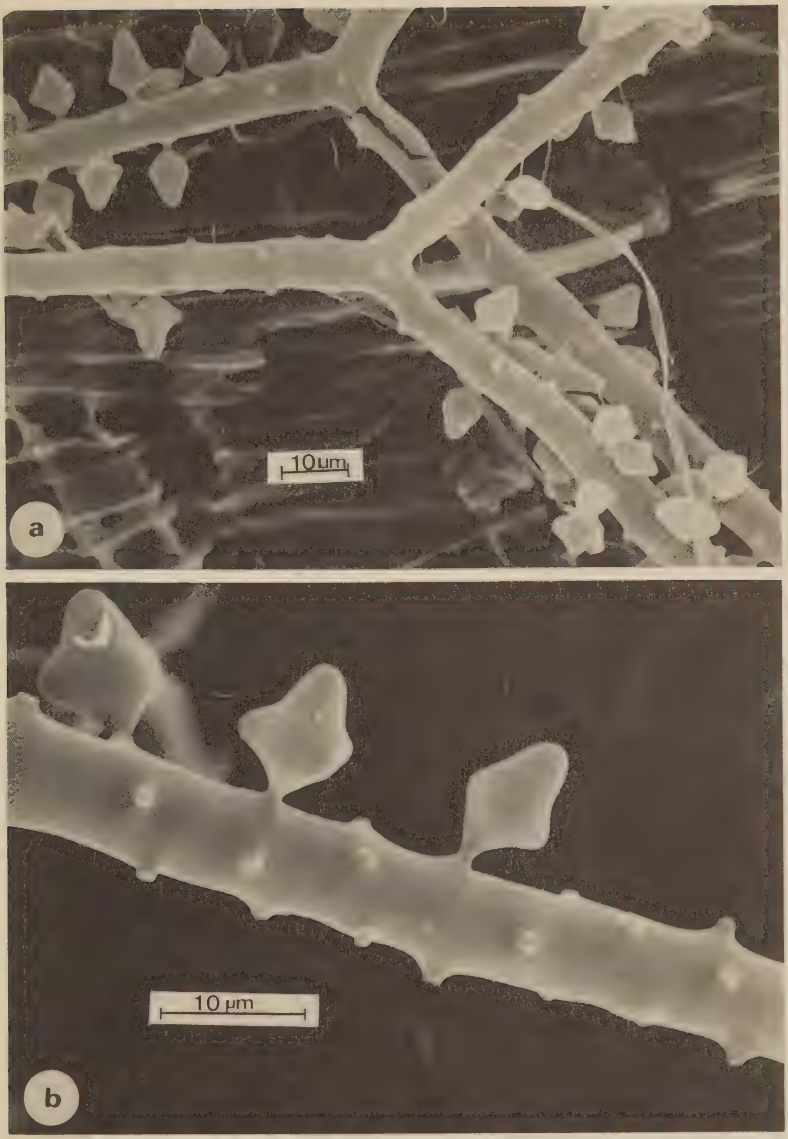

Fig. 5. *Rhinocladium mexicanum* sp. nov. **a**. Conidiophores. **b**. Conidiogenous cells denticulate and conidia rhomboidal or heart shape.

REFERENCES

Ellis, M. B. 1972. Dematiaceous Hyphomycetes XI. Mycological Papers 131: 1-25.

Ellis, M. B. 1976. More Dematiaceous Hyphomycetes. CMI, Kew, Surrey. 507 pp.

Furlanetto, C. and J. C. Dianese 1995. *Rhinocladium pulchrum*, a new record for Brazil and new combinations in *Rhinocladium*. Mycological Research 100 (2): 244-246.

Heredia, G. 1994. Hifomicetes dematiaceos en bosque mesófilo de montaña. Registros nuevos para México. Acta Botánica Mexicana 27: 15-32.

Heredia, G., A. Mercado-Sierra and J. Mena-Portales 1995. Conidial fungi from leaf litter in a mesophilic cloud forest of Veracruz, Mexico. Mycotaxon 55: 473-490.

Holubová-Jechová, V. 1987. Studies on Hyphomycetes from Cuba VI. New and rare species with tretic and phialidic conidiogenous cells. Ceská Mikologie 41: 107-114.

Holubová-Jechová, V. 1988. Studies on Hyphomycetes from Cuba VIII. A new genus *Piricaudilium* and some species new for the territory of Cuba. Ceská Mikologie 42: 200-204.

Holubová-Jechová, V. and A. Mercado-Sierra 1984. Studies on Hyphomycetes form Cuba II. Hyphomycetes from the Isla de la Juventud. Ceská Mikologie 38: 97-120.

Hughes, S. J. 1980. New Zealand Fungi 29. *Rhinocladium* Sacc. et March. New Zealand Journal of Botany 18: 163- 172.

Kirk, P. M. 1986. New or interesting microfungi XV. Miscellaneous hyphomycetes from British Isles. Trans. Br. Mycol. Soc. 86(3): 409-428.

Matsushima, T. 1981. Matsushima Mycological Memoirs No.2. Published by the author. Kobe, Japan 68 pp.

Matsushima, T. 1987. Matsushima Mycological Memoirs No.5. Published by the author. Kobe, Japan 100 pp.

Mena-Portales, J., G. Heredia and A. Mercado-Sierra 1995. Especies de *Bipolaris* y *Curvularia* halladas sobre hojas de *Quercus* y *Liquidambar* en el estado de Veracruz, México. Revista

Mexicana de Micología 11: 109-121.

Mercado-Sierra, A., R. F.Castañeda-Ruiz 1987. Nuevos o raros hifomicetes de Cuba I. Especies de *Cacumisporium*, *Guedea*, *Rhinocladium* y *Veronaea*. Acta Botánica Cubana 50:1-7.

Mercado-Sierra, A. and G. Heredia 1994. Hyphomycetes asociados a restos vegetales en el estado de Veracruz, México. Revist. Mexicana de Micología 10: 33-48.

Mercado-Sierra, A., G. Heredia and J. Mena-Portales 1995. New species of dematiaceous hyphomycetes from Veracruz, Mexico. Mycotaxon 55:491-499.

Moore, R.T. 1958. Deuteromycetes I: The *Sporidesmium* complex. Mycologia 50: 681-692.

Rzedowski, J. 1988. Vegetación de México. LIMUSA, México. 432pp.

Wang, C. J. K. and B. C. Sutton 1982. New and rare lignicolous hyphomycetes. Mycologia 74(3): 489-500.

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NOTES ON CONIDIAL FUNGI XII. NEW OR INTERESTING HYPHOMYCETES FROM CUBA

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ABSTRACT

Idriella mycophila anam. sp. nov., distinguished by non-septate, cylindrical to fusiform, slightly uncinate conidia, found on conidiophores and conidia of *Chalara* sp., and *Spadicoides obclavata* var. *heterocolorata* var. nov. are described and illustrated. Two new combinations into *Paratrichoconis* are proposed and three conidial fungi are recorded for the first time from Cuba.

Key words: *Idriella, Paratrichoconis, Spadicoides,* tropical fungi, hyphomycetes, systematics, Cuba.

RESUMEN

Se describen e ilustran *Idriella mycophila* anam. sp. nov. caracterizada por sus conidios no septados, de cilíndricos a fusiformes, ligeramente uncinados, hallada sobre conidióforos y conidios de *Chalara* sp., y *Spadicoides obclavata* var. *heterocolorata* var. nov. Se proponen dos nuevas combinaciones en *Paratrichoconis,* y se citan por primera vez para Cuba tres hongos conidiales.

Palabras clave: *Idriella, Paratrichoconis, Spadicoides,* hongos tropicales, hifomicetes, sistemática, Cuba.

Idriella mycophila Castañeda Ruíz, Guarro et Cano, *anam. sp. nov.* Figs. 1,2

Ad fungos conidiales, pertinens ad hyphomycetes. Coloniae funiculosae, mycophilae, brunneae. Mycelium plerumque superficiale, ex hyphis septatis, ramosis, laevibus, brunneis, 1-2 µm diam., compositum. Conidiophora conspicua, mononematosa, simplicia (interdum in cellula conidiogena reducta), interdum ramosa, erecta, subulata, sed in apice leviter nodosa, laevia, 0-1-septata, 10-30 x 2.5-4 µm, in basi brunnea vel dilute brunnea, in apice subhyalina. Cellulae conidiogenae polyblasticae, terminales, interdum discretae, subhyalinae, inconspicue denticulatae, in conidiophoris incorporatae. Conidia anguste comma-formia usque claviformia, obtusa ad apicem, leviter curvata, attenuata et trucata ad basim, unicellularia, laevia, 7-13 x 1-1.5 µm, sicca, hyalina. Chlamydosporae nullae in agaro farina avenaceae. Teleomorphosis ignota.

***Matrix**: In conidiophoris et conidiis Chalarae sp. in foliis putridis, Santiago de Cuba, La Gran Piedra, Cuba, legit R.F. Castañeda Ruíz, 2-XI-1994.*

Holotypus: INIFAT C94/131, Santiago de Las Vegas, Cuba.

Conidial fungi, hyphomycetes. Colonies funiculose, mycophilous, brown. Mycelium mostly superficial. Hyphae septate, branched, smooth, brown, 1 - 2 µm diam. Conidiophores differentiated (sometimes reduced to conidiogenous cell), mononematous, unbranched, occasionally branched, erect, subulate, but slightly nodose at the apex, smooth, 0-1-septate, 10 - 30 x 2.5 - 4 µm, brown to pale brown at the base, subhyaline at the apex. Conidiogenous cells polyblastic, terminal, sometimes discrete, subhyaline, denticulate, integrated. Conidia narrowly comma-shaped to clavate, obtuse at the apex, slightly curved, attenuate and truncate at the base, one-celled, smooth, 7 - 13 x 1 - 1.5 µm, dry, hyaline. Chlamydospores absent on oat meal agar. Teleomorph unknown.

Matrix: On conidiophores and conidia of *Chalara* sp. on rotten leaves, Santiago de Cuba, La Gran Piedra, Cuba, col. R. F. Castañeda Ruiz, November 2, 1994.
Holotype: INIFAT C94/131, Santiago de Las Vegas, Cuba.
Cultures ex type deposited: INIFAT C94/131, CBS 192.95, MUCL 39156.

Idriella mycophila superficially resembles *I. taiwanensis* Matsushima (1980) and *I. jambosae* Castañeda Ruíz et Kendrick (1991), but is different in conidial morphology and size. *I. taiwanensis* has cylindrical to fusiform conidia, 12 - 19 x 2 - 3 µm and in *I. jambosae* they are cylindrical, asymmetrical, 3 - 5 x 1 - 1.5 µm. The other published species of *Idriella* (Morgan-Jones, 1979; v. Arx, 1981; Castañeda Ruíz, 1985 a, b, 1986; Matsushima, 1975, 1985; Subramanian & Bhat, 1987) are very different from *I. mycophila.*

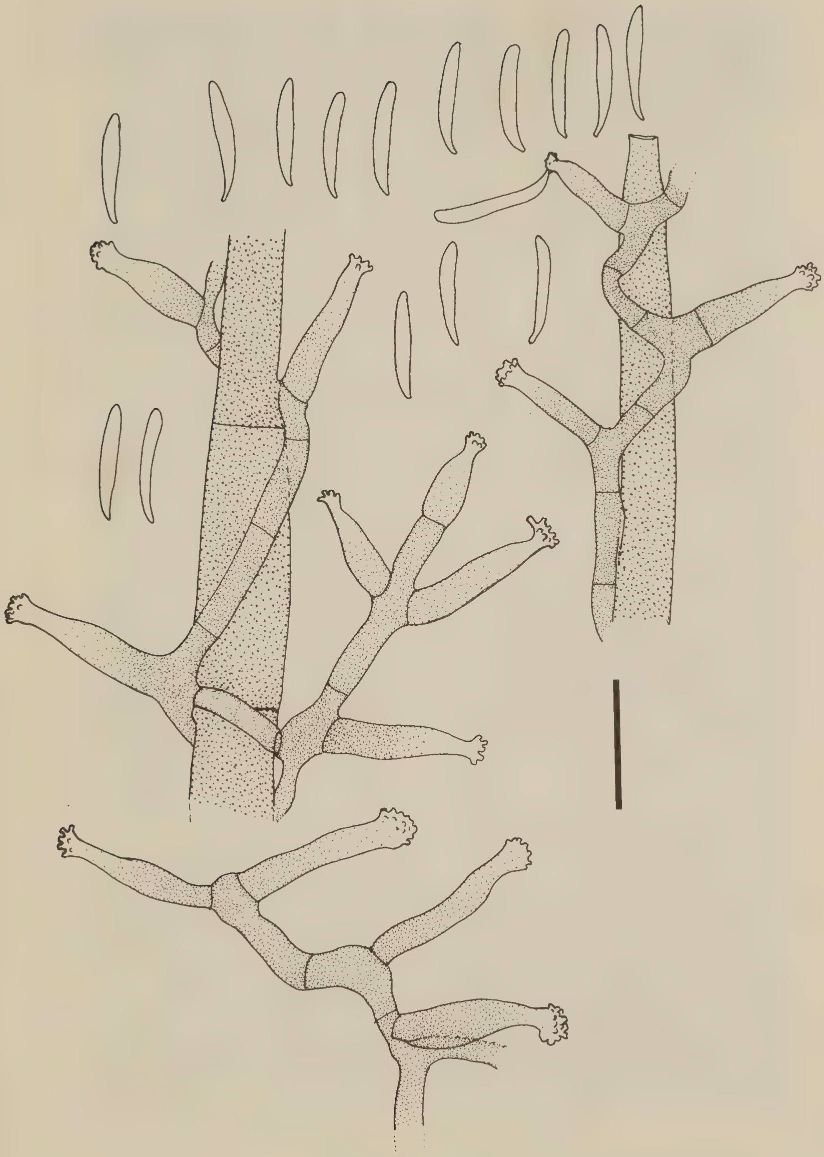

Fig.1.- *Idriella mycophila* (INIFAT C94/131). Conidiophores, conidiogenous cells and conidia (bar = 10 µm)

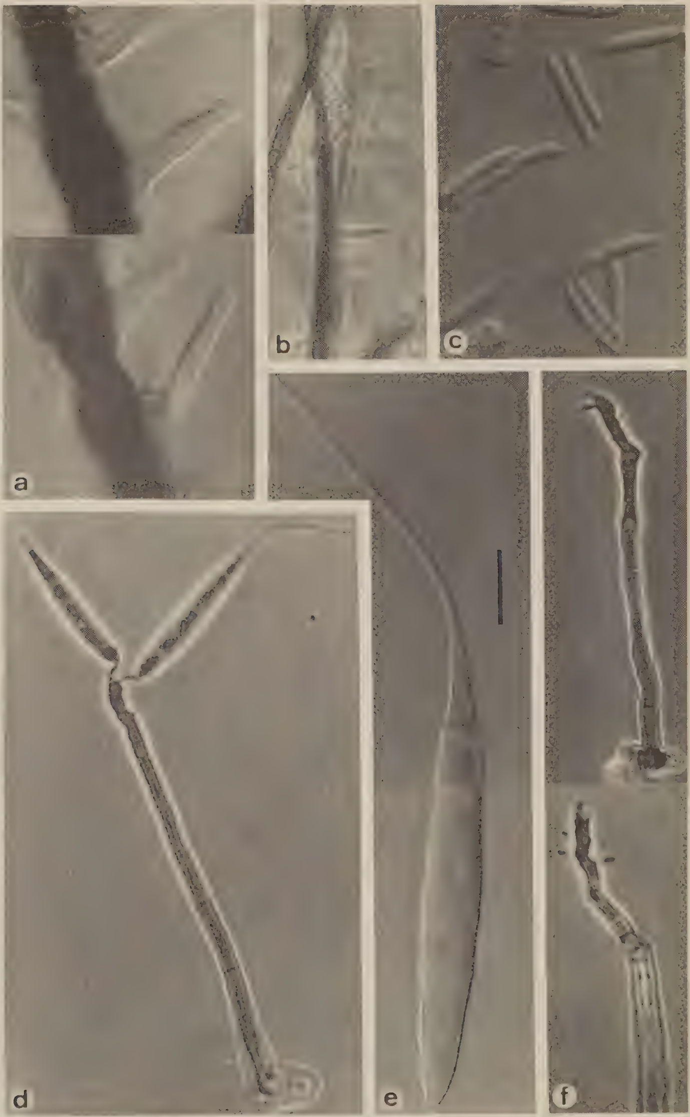

Fig.2.- *Idriella mycophila* (INIFAT C94/131). a,b, Conidiophores and conidiogenous cells; c, Conidia (a, c, bar = 10 µm; b, bar = 25 µm).
Paratrichoconis antillana (INIFAT C94/21). d, Conidiophore, conidiogenous cells and conidia; e, conidium; f, Conidiophores and conidiogenous cells (d, f, bar = 25 µm; e, bar = 10 µm).

Paratrichoconis antillana (Castañeda Ruiz) Castañeda Ruiz, *comb. nov.*
Figs. 2.3

Basionym: *Camposporium antillanum* Castañeda Ruiz, Deuteromycotina de Cuba. Hyphomycetes III, pag.2 (1985). Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt", Habana.

Colonies spreading, hairy, amphigenous, brown. Mycelium superficial and immersed. Hyphae septate, branched, smooth-walled, brown to pale brown, 1 - 2 µm diam. Conidiophores differentiated, mononematous, erect, straight, subulate, 5 - 10 septate, smooth, unbranched, 100 - 260 x 8 - 10 µm. Conidiogenous cells polyblastic, sympodial, terminal, denticulate, pale brown. Separating cells cylindrical, subhyaline, 3.5 - 6 µm long. Conidia obclavate to slightly fusiform, slightly unequilateral, 45 - 55 x 6 - 8 µm, hyaline to subhyaline, fimbriate at the base, dry, smooth-walled with an apical, filiform, appendage 15 - 40 µm long. Teleomorph unknown.

Specimen examined: INIFAT C85/36 (holotype); INIFAT C94/21, (MUCL 39190) on dead leaves of *Theobroma cacao*, Santiago de las Vegas, INIFAT Campus, C. Habana, Cuba, col. R. F. Castañeda Ruiz, January 15. 1994.

The genus *Paratrichoconis* Deighton & Pirozynski (1972), is characterized by its differentiated, brown conidiophores and polyblastic, integrated, terminal or intercalary, sympodial, denticulate conidiogenous cells; each denticle is clearly separated from the conidiogenous cell by a septum to form a separating cell and conidia septate, narrowly ellipsoid or fusiform to obclavate, septate, hyaline to subhyaline, sometimes with a cellular appendage at the apex. *Camposporium* Harkness (Ellis, 1971) is a similar genus but conidia are pigmented.

We recently collected a specimen from the East of Cuba which is a typical *Paratrichoconis* resembling *P. chinensis* (Hansf.) Deighton & Pirozynski. An identical fungus had been described as *Scolecobasidium fusarioides* by Matsushima (1993). It has clear separating cells and rhexolytic conidial secession. The following new combination is proposed:

Paratrichoconis fusarioidea (Matsushima) Castañeda Ruíz, Guarro et Cano *comb. nov.*
Figs. 4,5

Basionym: *Scolecobasidium fusarioides* Matsushima Matsushima Mycological Memoirs 7: 65 (1993) T. Matsushima, Kobe.

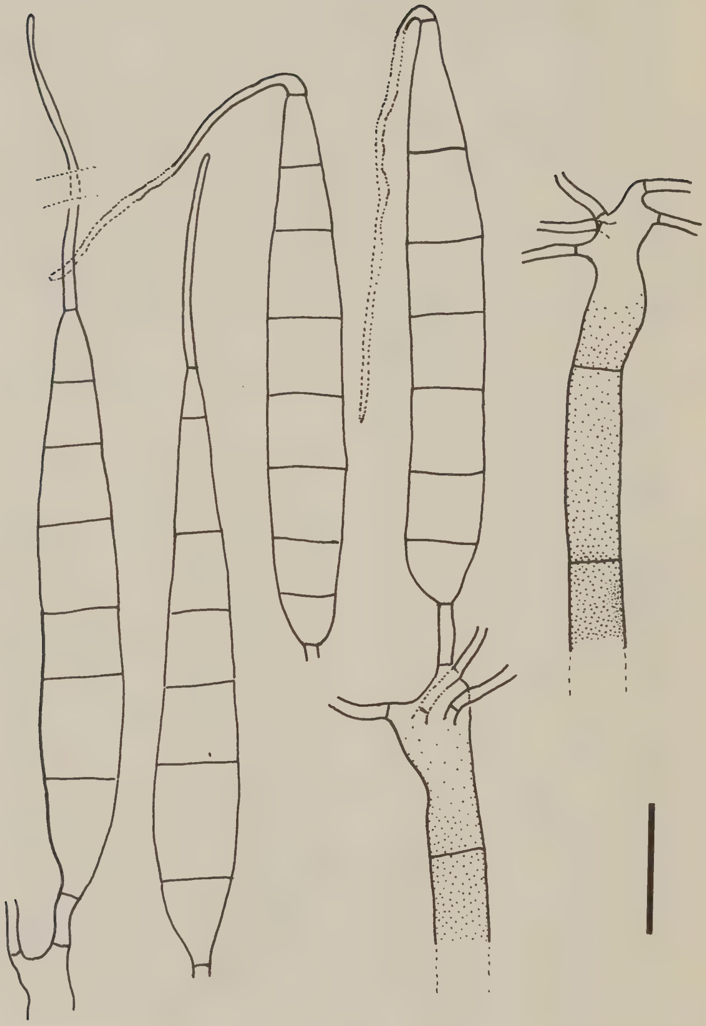

Fig.3.- *Paratrichoconis antillana* (INIFAT C94/21). Conidiophores, conidiogenous cells and conidia (bar = 10 µm)

Colonies on substrate hairy, spreading, pale brown. Mycelium mostly superficial. Hyphae septate, branched, smooth-walled, brown, 1.5 - 2.5 µm diam. Conidiophores conspicuous, mononematous, upright, straight, flexuous or slightly geniculate, unbranched, 0 - 3 septate, smooth, brown at the base, subhyaline at the apex, 20 - 40 x 4 - 4.5 µm. Conidiogenous cells polyblastic, terminal, denticulate, integrated, sympodial, pale brown. Separating cells cylindrical-filiform, subhyaline, 2 - 3.5 µm long. Conidia obclavate to subfusiform, apex obtuse, base with a conspicuous scar and remains the separating cell, (3) 6 - 7 septate, smooth, subhyaline or pale olive-colored, inequilateral, sometimes slightly curved, dry, (12) 32 - 50 x (2.5) 3 - 4 µm.

Specimen examined: INIFAT C94/158 (MUCL 39151, CBS 210.95 and IMI 367532), on sporophores of unidentified myxomycete on rotten leaves. Santiago de Cuba, La Gran Piedra, Cuba, col. R. F. Castañeda Ruiz, November 2, 1994.

The main difference between *P. fusarioidea* and *P. chinensis* is the conidia shape, which is fusiform in the latter.

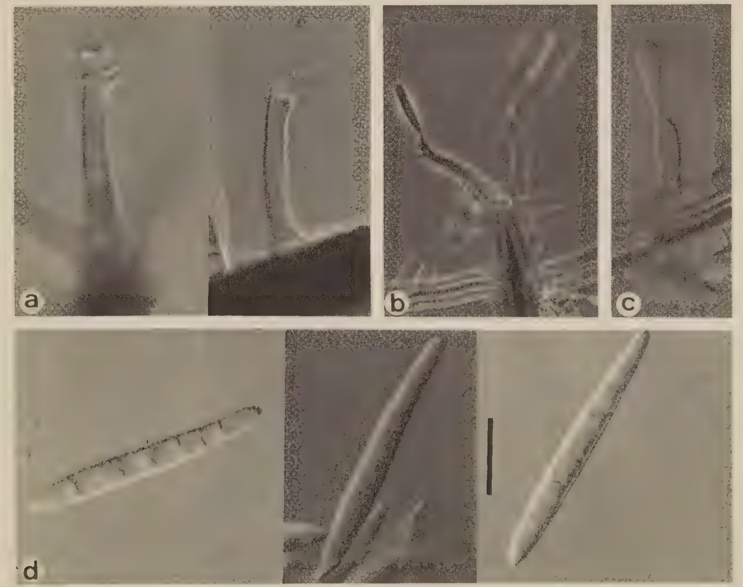

Fig.4.- *Paratrichoconis fusarioidea* (INIFAT C94/158). a, Conidiophores and conidiogenous cells; b,c, Conidiophore, conidiogenous cells and conidia; d, Conidia, (a, c, d, bar = 10 µm; b, bar = 25 µm).

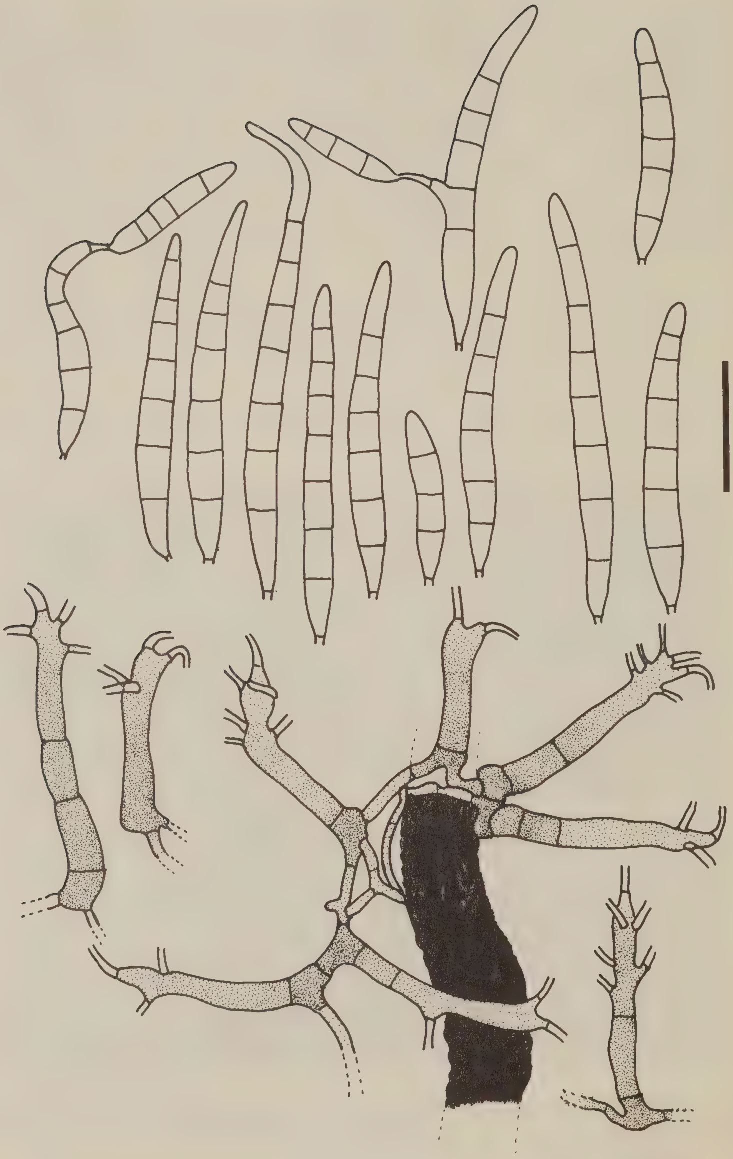

Fig.5.- *Paratrichoconis fusarioidea* (INIFAT C94/158). Conidiophores, conidiogenous cells and conidia, (bar = 10 µm).

Spadicoides obclavata A.J. Kuthubutheen et A. Nawawi var. ***heterocolorata*** Castañeda Ruíz, Guarro et Cano *var. nov.* Figs. 6,7

Ad fungos conidiales, pertinens ad hyphomycetes. Coloniae effusae, pilosae, atrobrunneae, amphigenae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, ramosis, laevibus, 2-3 µm diam., compositum. Conidiophora conspicua, mononematosa, eramosa interdum ramosa, saepe in apice ramosa, cylindrica, erecta, recta, 6-13 septata, heterocolorata (in basi et in septis atrobrunnea, plerumque in apice atrobrunnea sed saepissime cum cellulis centralibus brunneis vel atrobrunneis et prope septis dilute brunneis); laevia, usque ad 420 µm longa et 6-10 µm lata. Cellulae conidiogenae polytreticae, sympodiales, terminales et intercalares, poris manifestis praeditae. Conidia obclavata, 1-(2) septata, laevia, sicca, cum cellulis basalibus atrobrunneis et cellulis apicalibus brunneis vel dilute brunneis, 16-25 x 3.5-5 µm. Synanamorphosis: ***Selenosporella*** *similis, conidii et saepe conidiophororum cellulae apicales in cellulas conidiogenas polyblasticas denticulatae convertuntur; microconidia anguste, fusiformia, non septata, hyalina, 4-7 x 0.5-1 µm.*

Matrix: *In foliis dejectis non determinatis, Viñales, Pinar del Río, Cuba, leg. R. F. Castañeda Ruiz, 11-XI-1994.*

Holotypus: INIFAT C94/166, Santiago de Las Vegas, Cuba.

Conidial fungi, hyphomycetes. Colonies spreading, hairy, dark brown, amphigenous. Mycelium superficial and immersed. Hyphae septate, branched, smooth, 2 - 3 µm diam. Conidiophores differentiated, mononematous, unbranched, sometimes branched at the apex, cylindrical, erect, straight, 6 - 13 septate, versicolored, dark brown at the base and septa, mostly dark brown at the apex, but very often with central cells brown to dark brown and pale brown near septa; smooth, up to 420 x 6 - 10 µm. Conidiogenous cells polytretic, sympodial, terminal and intercalary, with evident pores. Conidia obclavate, 1 - 2 septate, mostly 1-septate, smooth, dry, with basal cell dark brown and apical cells brown to pale brown, 16 - 25 x 3.5 - 5 µm. Synanamorph: ***Selenosporella***-like, the apical cell of the conidia and sometimes the apical cell of the conidiophores become polyblastic conidiogenous cells; microconidia narrow fusiform, one celled, hyaline, 4 - 7 x 0.5 - 1 µm.

Matrix: on unidentified dead leaves, Viñales, Pinar del Río, Cuba, col.
R.F. Castañeda, November 11, 1994.
Holotype: INIFAT C 94/166, Santiago de Las Vegas, Cuba.

Spadicoides obclavata var. *heterocolorata* strongly resembles *S. obclavata var. obclavata* A. J. Kuthubutheen & A. Nawawi (1991); both have the same conidial morphology and size, but conidiophores in the former are tipically

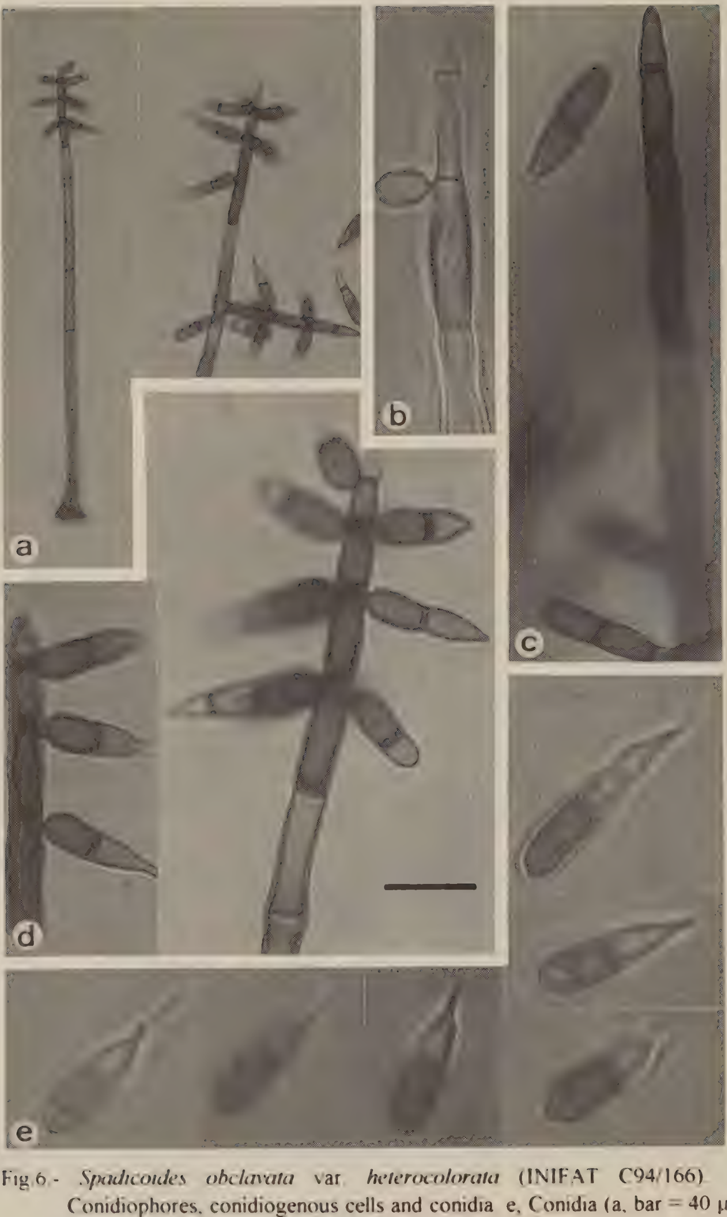

Fig.6.- *Spadicoides obclavata* var. *heterocolorata* (INIFAT C94/166). a,b,c,d, Conidiophores, conidiogenous cells and conidia. e, Conidia (a, bar = 40 µm; b-e, bar = 10 µm)

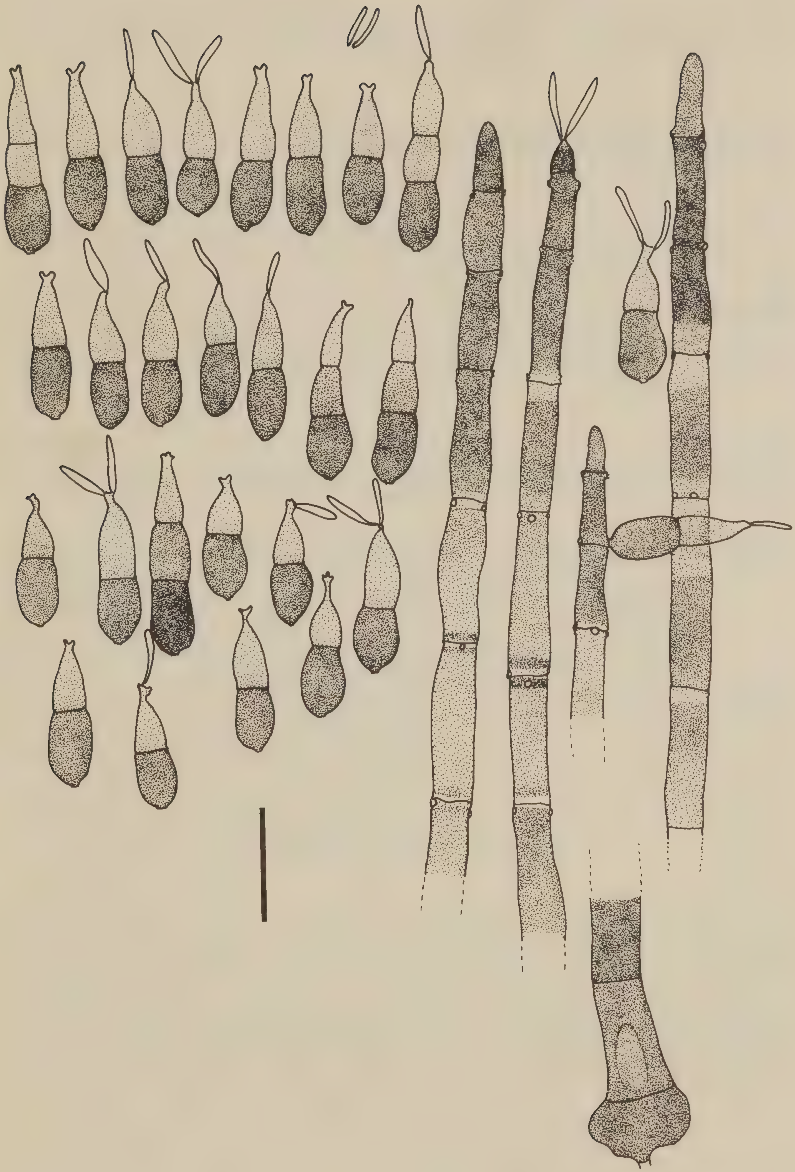

Fig.7.- *Spadicoides obclavata* var. *heterocolorata* (INIFAT C94/166). Conidiophores, conidiogenous cells and conidia. (bar = 10 µm)

darkly pigmented at the apex and in the centre of the upper cells and pale brown at the septa, whereas *Spadicoides obclavata var. obclavata* has conidiophores which are dark brown towards the base and brown to pale brown at the apex, and the conidia are 2-septate.

Other Conidial Fungi recorded for the first time from Cuba.

Dictyosporium micronesicum Matsushima, Matsushima Mycological Memoirs **2**:8 (1981). Matsushima, Kobe.

Specimens examined: INIFAT C90/50-3, on rotten leaves of unidentified plant. Santiago de las Vegas, Cuba. col. R. F. Castañeda Ruiz, January 26, 1990. INIFAT C92/115, on rotten leaves, Viñales, Pinar del Río, Cuba. col. R. F. Castañeda Ruiz, April 14, 1992.

Circinotrichum ponmudiensis Varghese & Rao, Botaniska Notiser **131:** 215 (1978).

Specimens examined: INIFAT C91/10, on dead leaves of *Bucida palustris*, San José de las Lajas, Habana, Cuba. col. R. F. Castañeda Ruiz, January 7, 1991. INIFAT C91/163, on dead leaves of *Pimenta dioica,* Santiago de las Vegas, Cuba. col. R. F. Castañeda Ruiz, June 15, 1991. INIFAT C94/85, on rotten leaves, Santiago de Cuba, Cuba. col. R. F. Castañeda Ruiz, November 6, 1994.
Cultures deposited: INIFAT C94/85 (=CBS 185.95).

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REFERENCES

Arx, J. A. von (1981): Notes on *Microdochium* and *Idriella*. Sydowia **34**: 30-38.

Castañeda Ruíz, R. F. (1985 a): Deuteromycotina de Cuba. Hyphomycetes II. Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt", Habana 23 pp.

Castañeda Ruíz, R. F. (1985 b): Deuteromycotina de Cuba. Hyphomycetes. Revista del Jardín Botánico Nacional **6**: 47-67.

Castañeda Ruíz, R. F. (1986): Fungi Cubenses. Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt", Habana, 64 pp.

Castañeda Ruíz, R. F. & Kendrick, B. (1991): Ninety-nine conidial fungi from Cuba and three from Canada. University of Waterloo Biology Series **35**: 1-132.

Deighton, F. C. & Pirozynski, K. A. (1972): Microfungi V. More hyperparasitic hyphomycetes. Mycological Paper **128**: 1-110.

Ellis, M. B. (1971): Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew.

Kuthubutheen, A. J. & Nawawi, A. (1991): Two new species of *Spadicoides* from Malaysia. Mycological Research **95**: 163-168.

Matsushima, T. (1975): Icones microfungorum a Matsushima lectorum. Published by T. Matsushima, Kobe.

Matsushima, T. (1985): Matsushima Mycological Memoirs **4**: 1-68, published by T. Matsushima, Kobe.

Matsushima, T. (1993): Matsushima Mycological Memoirs **7**: 1-75+131pls, published by T. Matsushima, Kobe.

Morgan-Jones, G. (1979): Notes on Hyphomycetes XXX. On three species of *Idriella*. Mycotaxon **8**: 402-410.

Subramanian, C. V. & Bhat, D. J. (1987): Hyphomycetes from South India I. Some new taxa. Kavaka **15**: 41-74.

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NOTES ON CONIDIAL FUNGI. XIII.
A NEW SPECIES OF *CLADOSPORIUM* FROM CUBA

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ABSTRACT

Cladosporium helicosporum *anam.-sp. nov.*, found on dead leaves of *Laciasis divaricata* from a rainforest in Cuba, is described and illustrated. It is characterized by polyblastic, sympodially extending, and lightly scarred conidiogenous cells from which arise curved, sigmoid or coiled, pale brown conidia in acropetal chains. Some notes on relevant genera are given.

Key words: ***Alysidium, Alysidiopsis, Cladosporium, Helicomina, Retroconis***, systematics, tropical fungi, Cuba.

TAXONOMIC PART

Cladosporium helicosporum Castañeda et Kendrick, *anam.-sp. nov.* (Figs. 1, 2)

Ad fungos conidiales, hyphomycetes pertinens. ***Coloniae*** *effusae, velutinae, hypophyllae, brunneae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, ramosis, laevibus, brunneis, 2-2.5 µm diam. compositum.* ***Conidiophora*** *macronematosa, mononematosa, ramosa, erecta, septata, laevia, brunnea ad basim, pallidiora sursum, usque 250 µm alta, 4-7µm crassa ad basim, rami 50-170 µm longi.* ***Cellulae conidiogenae*** *polyblasticae, in conidiophoris et ramulis incorporatae, terminales et postea intercalares, sympodiales, manifeste cicatricatae, interdum leniter denticulatae, pallide brunneae, 5-21 x 2-2.5 µm.* ***Conidia*** *blastocatenata, multimorpha (ellipsoidea, fusiformia, cylindrica, Y-formia, sigmoidea, helicoidea usque uncinata; distalia conidia plerumque helicoidea vel sigmoidea), 0-2-septata, plerumque 0-septata, sicca, laevia, subhyalina usque pallide brunnea, 6-25 x 2-4 µm. Teleomorphosis ignota.*

Matrix*: In foliis dejectis Laciasis divaricatae* in silvae, La Chorrera, La Habana, Cuba.
Holotypus*:* INIFAT C92/207-1, *leg.* R. F. Castañeda *et* B. Kendrick, 14-IV-1992.
Isotypus*:* MUCL 39868.

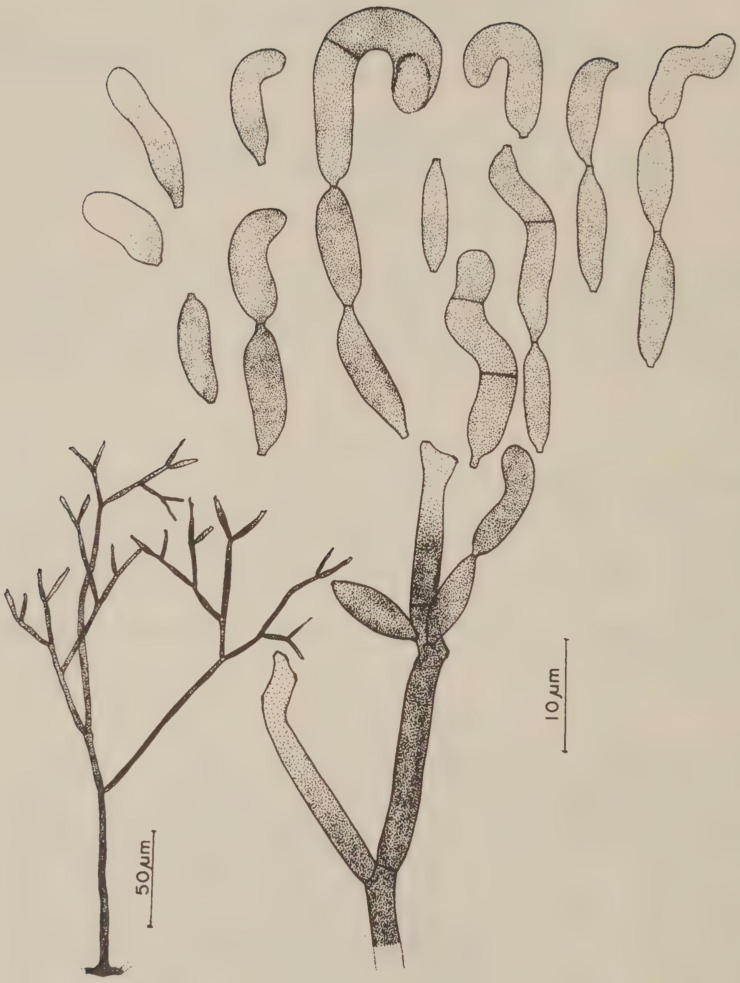
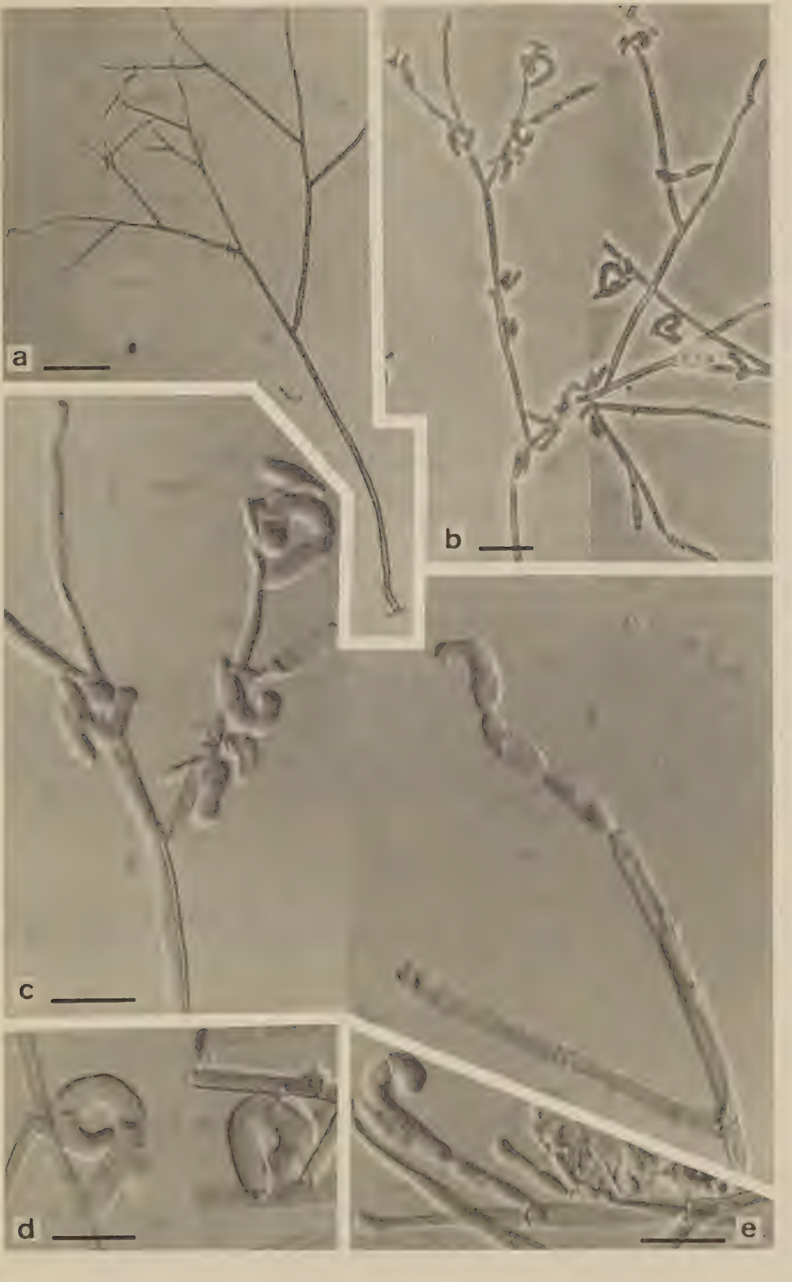


Fig. 1. ***Cladosporium helicosporum*** (INIFAT C92/207-1). Conidiophores, conidiogenous cells and conidia.

Fig. 2. ***Cladosporium helicosporum*** (INIFAT C92/207-1). Conidiophores, conidiogenous cells and conidia (scale bars: a = 50 μm, b = 40 μm, c-e = 10 μm) .


a
b
c
d
e

Conidial fungi, hyphomycetes. **Colonies** spreading, velvety, hypophyllous, brown. Mycelium partly superficial and partly immersed in the substrate. Hyphae septate, branched, smooth-walled, brown, 2-2.5 µm diam. **Conidiophores** macronematous, mononematous, branched, erect, septate, smooth-walled, brown at the base, pale above, up to 250 µm tall, 4-7 µm wide at the base, branches 50-170 µm long. **Conidiogenous cells** polyblastic, integrated on conidiophores and branches, terminal but becoming intercalary, sympodial, with conspicuous scars, sometimes slightly denticulate, pale brown, 5-21 x 2-2.5 µm. **Conidia** blastocatenate, variable in shape (ellipsoid, fusiform, cylindrical, Y-shaped, sigmoid, helicoid to uncinate; distal conidia mostly helicoid or sigmoid), 0-2-septate, mostly 0-septate, dry, smooth-walled, subhyaline to pale brown, 6-25 x 2-4 µm. Teleomorph unknown.

Habitat: On dead leaves of *Laciasis divaricata* from a rainforest, La Chorrera, La Habana, Cuba.
Holotype: INIFAT C92/207-1, R.F. Castañeda and B. Kendrick, 14 Apr. 1992.
Isotype: MUCL 39868.

The conidial ontogeny of ***C. helicosporum*** is typical of ***Cladosporium*** Link (de Vries 1952; Ellis 1971, 1976; Matsushima 1975; Castañeda 1987; Castañeda and Kendrick 1991) and also of several closely similar genera such as ***Alysidium*** Kunze (Ellis 1971; Castañeda 1986; Castañeda and Kendrick 1990, 1991), ***Alysidiopsis*** Sutton (1973; Arnold and Castañeda, 1986) and ***Retroconis*** de Hoog & Batenburg-Van der Vegte (1989). It is sometimes difficult to establish morphological distinctions among those genera (Kendrick 1980). However, no previously described species of any of the above-mentioned genera has coiled or sigmoid conidia like those of ***C. helicosporum***.

The conidia of ***Helicomina*** Olive show some resemblance (Ellis 1971, 1976) and its conidiogenous cells are also polyblastic. However, the conidia are always solitary (never in chains). Despite the singular characteristics of our new species, we do not propose a new genus for it, because its conidial ontogeny and arrangement of its conidiophores and conidial chains can be accommodated within the current concept of ***Cladosporium***.

ACKNOWLEDGMENTS

We are indebted to Dr Enrique Descals (Inst. Estudis Avançats de les Illes Balears, U.I.B./C.S.I.C.) for serving as pre-submission reviewer, and to the Cuban Ministry of Agriculture for research facilities.

REFERENCES

ARNOLD, G.R.W. and R.F. CASTAÑEDA RUIZ. 1986. Neue Hyphomyzeten-arten aus Kuba. *Feddes Repertorium* **97**: 79-88.

CASTAÑEDA RUIZ, R.F. 1986. Deuteromycotina de Cuba. Hyphomycetes IV. Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt", Habana, 17 pp.

CASTAÑEDA RUIZ, R.F. 1987. Fungi Cubenses: II. Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt", Habana, 22 pp.

CASTAÑEDA RUIZ, R.F. and B. KENDRICK. 1990. Conidial fungi from Cuba: I. *University of Waterloo Biology Series* **32**: 1-53.

CASTAÑEDA RUIZ, R.F. and B. KENDRICK. 1991. Ninety-nine conidial fungi from Cuba and three from Canada. *University of Waterloo Biology Series* **35**: 1-132.

DE HOOG, G.S. and W.H. BATENBURG-VAN DER VEGTE. 1989. ***Retroconis***, a new genus of ascomycetous Hyphomycetes. *Studies in Mycology* **31**: 99-105.

DE VRIES, G.A. 1952. *Contribution to the knowledge of the genus* ***Cladosporium.*** Centraalbureau voor Schimmelcultures, Baarn, 121 pp.

ELLIS, M.B. 1971. *Dematiaceous Hyphomycetes.* Commonwealth Mycological Institute, Kew, 608 pp.

ELLIS, M.B. 1976. *More Dematiaceous Hyphomycetes.* Commonwealth Mycological Institute, Kew, 507 pp.

KENDRICK, B. 1980. The generic concept in hyphomycetes - a reappraisal. *Mycotaxon* **11**: 339-364.

MATSUSHIMA, T. 1975. *Icones Microfungorum a Matsushima lectorum.* T. Matsushima, Kobe, 209 pp.

SUTTON, B.C. 1973. Hyphomycetes from Manitoba and Saskatchewan, Canada. *C.M.I. Mycological Papers* **132**: 1-143.

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PERONOSPORA ON *FRAGARIA*

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Abstract. The presence of *Peronospora* on *Fragaria,* a previously disputed fungus-host association, is confirmed from collections in Romania. The fungus is described, illustrated, and ascribed to *Peronospora sparsa.*

Peronospora fragariae Roze & Cornu, an oomycetous fungus parasitic on *Fragaria vesca* L, was originally described from Montmorency near Paris, France (Cornu 1876). No type or other original herbarium material has been preserved.

Schröter (1877) and Fischer (1892) considered that this fungus does not differ from the *Peronospora* parasitic on plants belonging to other genera of *Rosaceae,* such as *Agrimonia, Potentilla, Rubus*, and *Sanguisorba.* They regarded *P. fragariae* as a synonym of *P. potentillae* de Bary. Subsequently, several authors mentioned *Fragaria vesca* as host of *P. potentillae* (Berlese 1898; Jaczewski 1901; Berlese 1902). Nevertheless, other students of *Peronosporaceae* (Gäumann 1923; Jaczewski & Jaczewski 1931; Ul'yanishchev 1967; Novotel'nova & Pystina 1985; Ul'yanishchev *et al.* 1985) treated *P. fragariae* as a distinct taxon, confined to *Fragaria* spp., whereas Constantinescu & Negrean (1983) considered *Fragaria vesca* as one of the hosts of *Peronospora sparsa* Berk.

Viennot-Bourgin (1956) examined a specimen of *P. fragariae* distributed in Roumeguère, Fungi gallici exs. no. 1929 and found out that its host is *Potentilla sterilis* (L.) Garcke (=*Potentilla fragariastrum* Pers.) and not *Fragaria vesca* as indicated on the label. Although his observation was not based on the examination of the specimen collected and studied by the original authors, the presence of *Peronospora* on *Fragaria* was considered doubtful (Kochman & Majewski 1970; Skalický 1983; Hall 1989), and *Fragaria* was not mentioned as host in the compilation of names described in *Peronospora* (Constantinescu 1991).

Because doubts about the presence of *Peronospora* on *Fragaria* have been advanced, eight specimens of this fungus-host combination, collected in Romania between 1969 and 1981, were studied.

Description of the fungus

On the upper surface of attacked leaves, the tissues invaded by the fungus show symptoms ranging from yellowish discoloured areas, to numerous, 1–20 mm diam. spots, brownish to reddish brown, sometimes with a violaceous tinge, discrete or coalesced, and with diffuse margins. The *down* is hypophyllous, whitish and hardly visible in young stages, becoming ochre when mature, and consists of conidiophores, either solitary or aggregated in patches. *Conidiophores* slender, more or less straight, (360–) 418–737 (–1030) μm long; basal vesicle slightly bulbous, up to 16 μm wide; trunk (260–) 302–566 (–780) (n=29) μm long, of more or less uniform width, 5–7 (–11) μm at the base, 7–10 μm wide below the first branch; branches flexuous, dichotomously divided (3-) 4–6 times, ultimate branchlets subulate, up to 23 μm long, tip round; *conidia* when young almost globose, later broadly ellipsoidal, pale yellow, (17–) 18–21 (–23) μm long, (14–) 14·5–17 (–19) μm wide, length/breadth ratio (1·11–) 1·15–1·25 (–1·40) (n=68), broadest part median, rarely supra-median, wall 0·3–0·5 μm thick, smooth in young conidia, verruculose in mature ones, pedicel hardly visible. *Sexual organs* not found.

SPECIMENS EXAMINED. All on *Fragaria vesca* L., in Romania, collected by G. Negrean (except for 49862), and preserved in herb. BUCM. Prahova Co., Plopeni Forest, 19 June 1977 (49066); Suceava Co., Vatra Dornei, Dealul Negru, 11 Aug. 1980 (56614); ditto, Plaiul Bîrgău, 26 Aug. 1979, (54762); Gorj Co., Cheile Sohodolului, 9 July 1977 (49108); Dîmbovița Co., Bucegi Mts, Cheile Zănoagei, 12 Aug. 1976, (46249) Argeş Co., Podul Dâmboviței, Valea Crovului, 45 26 00N 25 15 46 E, Alt. *ca* 1000 m, 21 Oct. 1981, (67513); ditto, Iezer-Păpuşa, pârâul lui Geantă, 8 July 1969, A. Richițeanu (49862); Sălaj Co., Măgura Şimleului, 1 Sep. 1977 (49863).

Discussion

The hosts in the above specimens definitely belong to *Fragaria vesca*. In four out of eight specimens fruits are also present (Fig. 1). This eliminates all previous doubts about the existence of *Peronospora-Fragaria* combination.

According to Constantinescu (1996) the size and shape of conidia in *Peronospora* parasitic on *Rosaceae* allow the separation of two discrete units, *P. sparsa* and *P. potentillae*. The morphological characters of the fungus occurring on *Fragaria vesca* indicate that it belongs to *Peronospora sparsa* Berk., as described by Francis (1981), Hall *et al.* (1992), and Constantinescu (1996).

In adopting Viennot-Bourgin's (1956) view, Skalický (1983) considered *P. fragariae* a distinct species, but confined to *Potentilla sterilis*. He provided a description of this fungus based on the examination of specimens of *Peronospora* on *Potentilla sterilis* distributed in several exsiccatae and selected a neotype. We have also examined the duplicates of these exsiccatae and, in addition, the same fungus-host combination in the following collections: Roumeg. - Fungi gal. exs. No 2446, Roumeg. - Fungi sel. exs. No. 4644, Kunze - Fungi sel. exs. No. 588, and Herb. Barbey-Boissier No. 1490 (all in herb. UPS). The morphological characters of the fungus on *Potentilla sterilis* show that it differs from the fungus described here on *Fragaria,* and that it belongs to *Peronospora potentillae* de Bary *sensu lato.* In the most recent description of *Peronospora potentillae* (Hall 1991), *Potentilla sterilis* is listed as one of the host of this fungus.

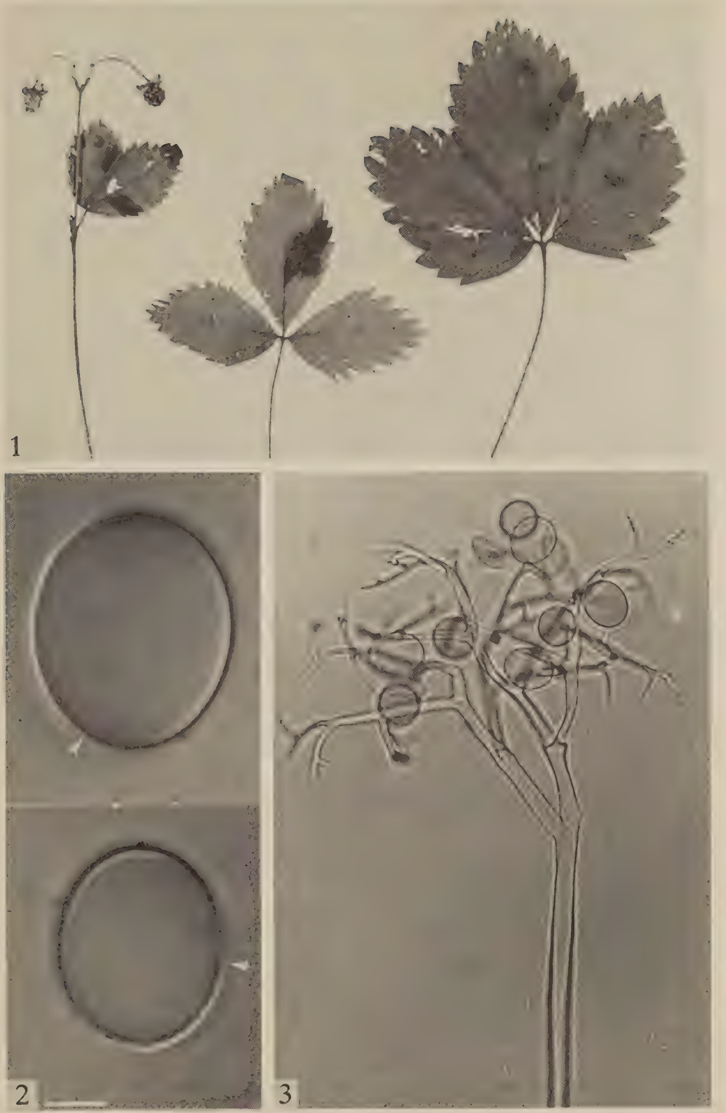

Fig. 1-3. *Peronospora sparsa* on *Fragaria vesca*. 1. Scape with pedicels and fruits, and leaves of *Fragaria*; the dark spots on leaves are the result of fungus attack. 2. Conidia showing wall ornamentation (arrowheads). 3. Conidiophore and conidia. Bar = 5 μm for 2, and 20 μm for 3. From BUCM 48108.

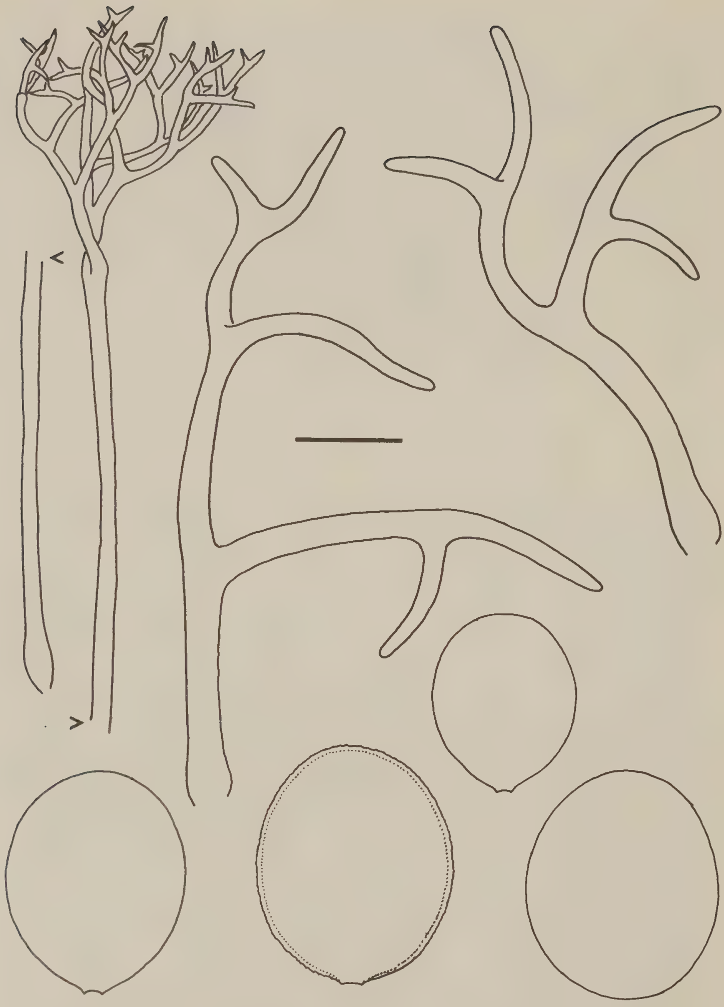

Fig. 4. *Peronospora sparsa* on *Fragaria vesca*. Conidiophore, ultimate branchlets, young and mature conidia. Bar = 40 μm for conidiophore, and 10 μm for ultimate branchlets and conidia. From BUCM 49066.

The possibility that Roze and Cornu mistook *Potentilla sterilis* for wild *Fragaria vesca* cannot be excluded. Although the presence of both plants around Paris is documented (Jeanpert 1953), it appears from the specimens collected in Romania that *Fragaria* is parasitized by *Peronospora* only in hilly or mountain areas. This is also supported by the occurrence records of this fungus-host association from Caucasus (Ul'yanishchev 1967; Novotel'nova & Pystina 1985; Ul'yanishchev *et al.* 1985). Nevertheless, in the absence of the type specimen it cannot be excluded that *P. fragariae* has been, indeed, described from *Fragaria.* Consequently, Skalický's (1983) interpretation of *P. fragariae* is untenable. The epithet *Peronospora potentillae-sterilis* Gäum. (1923) relegated to synonymy of *P. fragariae* by Skalický, may well be the correct name for the fungus parasitic on *Potentilla sterilis,* if a narrower species concept is applied. *Peronospora fragariae* should be considered conspecific with *P. sparsa.*

In spite of the lack of original specimens, the information provided by Roze & Cornu (1876) may facilitate the identification of their fungus. According to them, the conidiophore length is 1 mm and the size of conidia '1/45–1/50 millim. longa, 1/55–1/60 millim. lata', i.e. 22–20 × 18–16 μm.The conidiophore length and the size of conidia place this fungus within the size range of *P. sparsa* Berk. Fischer (1892) wrongly transformed the figures given for conidia by Roze & Cornu to 20–40 × 17–36 μm which suggest *P. potentillae* rather than *P. sparsa.* These values were later utilised by several authors (Jaczewski & Jaczewski 1931; Ul'yanishchev 1967; Novotel'nova & Pystina 1985; Ul'yanishchev *et al.* 1985), and this error in conidia size may have also been a source of confusion regarding the fungus on *Fragaria.*

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Literature cited

Berlese, A.N. (1898). *Icones Fungorum. Phycomycetes. Fasc. I.* Padua.

Berlese, A.N. (1902). Saggio di una Monografia delle Peronosporacee. Part 5. *Riv. Patol. veg. , Pavia* **10**: 185-295.

Constantinescu, O. (1991). An annotated list of *Peronospora* names. *Thunbergia* **15**: 1-110.

Constantinescu, O. (1996). *Peronospora* on *Acaena* (*Rosaceae*). *Mycotaxon* **58**: 313-318.

Constantinescu, O. & Negrean, G. (1983). Check-list of Romanian *Peronosporales. Mycotaxon* **16**: 537-556.

Cornu, M. (1876). *Peronospora fragariae* Roze et Cornu (n. sp.). *Bull. Soc. bot. Fr.* **23**: 242

Fischer, A. (1892). *Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. 1 Bd. IV Abt. Phycomycetes.* 2nd Ed. pp. 383-490. E. Kumer: Leipzig.

Francis, S.M. (1981). *Peronospora sparsa. CMI Descr. Path. Fungi & Bact.* **690**: 1-2.

Gäumann, E. (1923). Beiträge zu einer Monographie der Gattung *Peronospora* Corda. *Beitr. Krypt. -Fl. Schweiz* **5**(4): 1-360.

Hall, G. (1989). Unusual or interesting records of plant pathogenic *Oomycetes. Pl. Path.* **38**: 604-611.

Hall, G. (1991). *Peronospora potentillae. IMI Descr. Path. Fungi & Bact.* **1061**: 1-2.

Hall, G., Cook, R.T.A. & Bradshaw, N.J. (1992). First record of *Peronospora sparsa* on *Prunus laurocerasus. Pl. Path.* **41**: 224-227.

Jaczewski, A.A. (1901). *Mycological Flora of European and Asiatic Russia. Vol. 1. Peronosporaceae*. Moskva. In Russian.

Jaczewski, A.A. & Jaczewski, P.A. (1931). *Indentification Book of Fungi. Vol. I. Phycomycetes*. 3rd Ed. Moskva-Leningrad. In Russian.

Jeanpert, H.E. (1953). *Vade-Mecum du Botaniste dans la Région Parisienne*. 2nd Ed. L. Lhomme: Paris.

Kochman, J. & Majewski, T. (1970). *Fungi (Mycota). Vol. IV. Phycomycetes, Peronosporales*. Panstwowe Wydawnictwo Naukowe: Warszawa. In Polish.

Novotel'nova, N.S. & Pystina, K.A. (1985). *Cryptogamic Flora of USSR. Vol. 11. Fungi (3). Peronosporales*. Nauka: Leningrad. In Russian.

Schröter, J. (1877). *Peronospora obducens* n.sp. *Hedwigia* **16**: 129-135.

Skalicky, V. (1983). The revision of species of the genus *Peronospora* on host plants of the family *Rosaceae* with respect to Central European species. *Folia geobot. phytotax. , Praha* **18**: 71-101.

Ul'yanishchev, V.I. (1967). *Mycoflora of Azerbaydzhan. IV. Peronosporaceous fungi*. Acad. Nauk Azerb.SSR: Baku. In Russian.

Ul'yanishchev, V.I., Osipian, L.L., Kanchaveli, L.A. & Akhundov, T.M. (1985). *Identification Book of Transcaucasian Fungi. Peronosporaceous Fungi*. Erevan. Univ. Erevan. In Russian.

Viennot-Bourgin, G. (1956). *Mildious, oidiums, caries, charbons, rouilles des plantes de France*. Paul Lechevalier: Paris.

MYCOTAXON

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NEW HETEROBASIDIOMYCETES FROM GREAT BRITAIN

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Six new heterobasidiomycete species are described from Great Britain, including members of the *Atractiellales*, *Filobasidiales*, and *Platygloeales*. *Chionosphaera coppinsii*, *Filobasidiella lutea*, *Achroomyces henricii*, *Occultifur corticiorum*, *Spiculogloea minuta*, and *Hormomyces peniophorae* are described as new. The new genus *Heteromycophaga* is proposed to accommodate *Heteromycophaga glandulosae*, considered to be an imperfect state of a mycoparasitic heterobasidiomycete. An additional two new auricularioid taxa are briefly described and illustrated, but not formally published. *Spiculogloea occulta* and *Achroomyces* cf. *bispora* are noted and illustrated as new to Britain.

ATRACTIELLALES

Chionosphaera coppinsii P. Roberts sp. nov. (Figs. 1 & 2)

Etym.: named for the collector and noted lichenologist, Brian J. Coppins.

Basidiomata inconspicua, gregaria, clavata vel subcapitata, substipitata, 100 - 200 x 50 - 150 µm, albida. *Hyphae* agglutinatae, 2 - 3 µm latae, fibulatae. *Basidia* cylindracea, 60 - 70 x 2.5 - 3.5 µm. *Basidiosporae* 4, sessiles, ellipsoideae vel subfusiformes, 7 - 9 x 3.5 - 4 µm.

In *Parmelia glabratula*, Inveralligan, Torridon, Wester Ross, Caledonia, 21 Jun. 1994, B.J. Coppins 16400 & A.M. O'Dare, **E**, holotypus.

Basidiomes scattered over lichen surface, small, not visible without a lens, 100 - 200 x 50 - 150 µm, weakly stipitate, clavate to subcapitate, white and furfuraceous above, with ceraceous, slightly pinkish stalks. *Hyphae* synnematous, agglutinated, hyaline, 2 - 3 µm wide, with thin or slightly gelatinized walls, with clamp connexions. *Basidia* tubular, slightly sinuous,

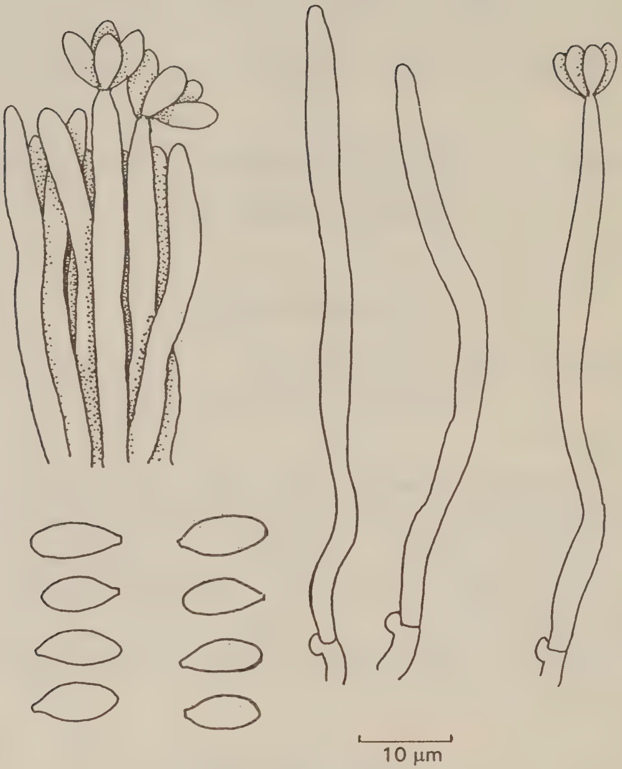


Fig. 1: ***Chionosphaera coppinsii:*** basidia and basidiospores [holotype, E].

60 - 70 x 2.5 - 3.5 µm, obtuse or narrowed at apex. *Sterigmata* absent. *Basidiospores* statismosporic but with small apiculus, arising from apex of basidia, 4 (possibly 6) per basidium, ellipsoid to subfusiform, 7 - 9 x 3.5 - 4 µm, not replicating, germination probably by yeast-like conidia, but not clearly seen.

Specimens examined: SCOTLAND: WESTER ROSS, Torridon, Inveralligan, wood & gorge of Abhainn Alligin, on *Parmelia glabratula* (Lamy) Nyl. on *Betula*, 21 Jun. 1994, B.J. Coppins 16400 & A.M. O'Dare, **E**, holotype; **K(M) 39188**, isotype; WEST SUTHERLAND, Invernaver N.N.R., Bettyhill, on moribund *Lecidella elaeochroma* (Ach.) M. Choisy on *Corylus*, 22 Aug. 1983, B.J. Coppins 10202, **E**.

When first seen, this small mycoparasite was tentatively referred to *Pachnocybe* Berk., *Chionosphaera* Cox, or *Fibulostilbum* Seifert & Oberw., though none of these genera were known to be lichenicolous. Since then, however, Diederich (1996) has published details of two similar taxa on lichens which have been referred to *Chionosphaera*, the type of which, *C. apobasidialis* Cox, is a mycoparasite of *Cladosporium* Link. The present species, *C. coppinsii*, differs from the known taxa in having conspicuous clamp connexions. Only 4-spored basidia were found in the type specimen (Fig. 1).

The second specimen (Coppins 10202, Fig. 2) differs from the type in having distinctly pinkish fruit bodies, shorter basidia (40 - 45 µm long), and 4 - 6 spores per basidium, the spores appearing slightly smaller (5 - 7.5 x 3 - 4.5 µm) than in the type. Since it also possesses conspicuous clamp connexions, it is referred *pro tem.* to *Chionosphaera coppinsii*, but may ultimately prove to be distinct.

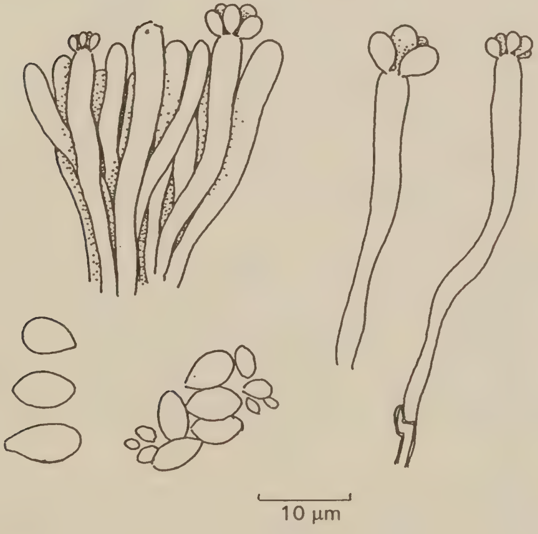


Fig. 2. ***Chionosphaera* aff. *coppinsii*:** basidia, basidiospores, and yeast-like spore germination [Coppins 10202, E].

FILOBASIDIALES

Filobasidiella lutea P. Roberts sp. nov. (Figs. 3 & 4)

Basidiomata effusa, primulina vel lutea, usque 2 cm lata, in hymenio *Hypochnicii vellerei* parasitica. *Hyphae* 3 - 3.5 µm latae, fibulatae. *Basidia* 120 - 250 µm longa, subclavata, apice partim septata. *Basidiosporae* sessiles, e gemmatione repetita gerentia, globosae, 4 - 6 µm latae.

In hymenio *Hypochnicii vellerei*, Lullingstone Park, Kent, Anglia, 8 Dec. 1991, J. Weightman & A. Henrici, **K(M) 18754**, holotypus.

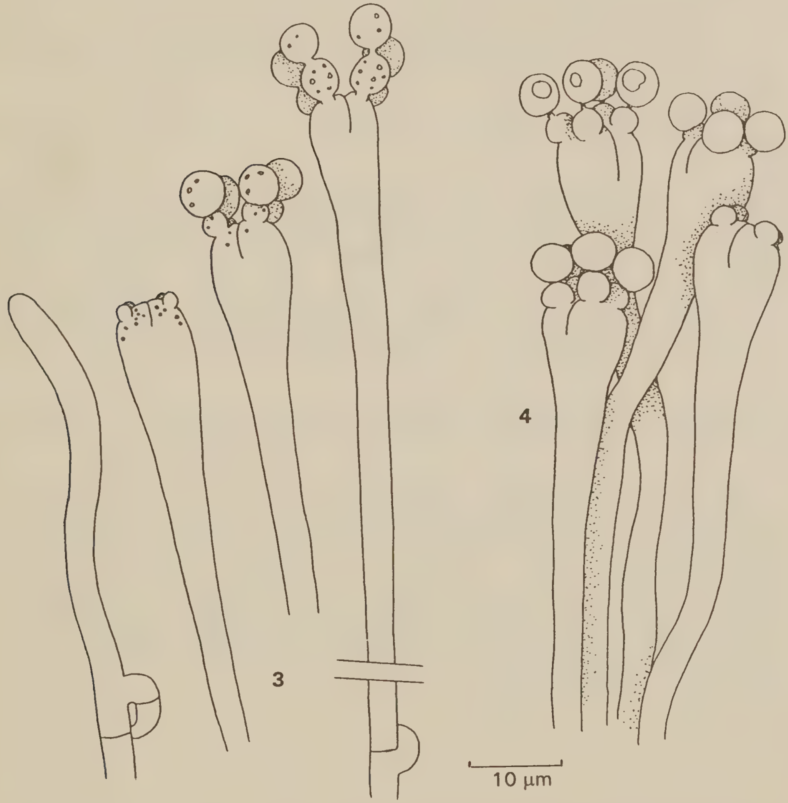
Basidiomes visible when well developed as effused, primrose yellow to pale luteous patches, up to 2 cm across, within the hymenium of the corticioid fungus, *Hypochnicium vellereum* (Ellis & Cragin) Parmasto. *Hyphae* 3 - 3.5 µm wide, hyaline, thin-walled, with clamp connexions (at least at base of basidia), difficult to distinguish from host hyphae. *Basidia* highly elongated, 120 - 250 µm long, clavate at apex and widening to 6.5 - 9 µm, partly septate at apex to a depth of 3 - 6 µm. *Sterigmata* none. *Basidiospores* statismosporic, produced by repeated budding from 4 apical loci, the first generation of spores not being released until the second generation has appeared; globose, 4 - 6 µm diam., cyanophilous, the walls slowly gelatinizing and thickening in KOH, germination not seen.

Specimens examined (all in hymenium of *Hypochnicium vellereum* on *Ulmus*): ENGLAND: DEVON, Torquay, Watcombe Woods, 6 Dec. 1991, P.J. Roberts 355, **K(M) 30401**; KENT, Lullingstone Park, 1 Dec. 1991, J. Weightman; same location, 8 Dec. 1991, J. Weightman & A. Henrici, **K(M) 18754**, holotype; same location, 22 Nov. 1992, J. Weightman, **K(M) 29182**; Basted, Long Wood, 3 Oct. 1993, J. Weightman & J. Pitt, **K(M) 24387**; MIDDLESEX, Perivale Wood, 24 Jan. 1989, A. Henrici, **K(M) 39187**; SURREY, Englefield Green, Cooper's Hill, 16 Dec. 1995, N.W. Legon, **K(M) 33342**; WESTMORLAND, Dufton Ghyllwood, 28 Sep. 1995, A. Henrici, **K(M) 32346**.

Filobasidiella lutea seems to be a common parasite of the corticioid fungus, *Hypochnicium vellereum*, yet one which has previously been overlooked. Macroscopically the yellow fruit bodies can be quite conspicuous, contrasting with the pale pinkish fruit bodies of the host. Microscopically the large, highly elongated basidia, the apical septation, the large globose basidiospores, and the presence of clamp connexions are distinctive.

Attempts to isolate *F. lutea* produced cultures containing abundant, thick-walled, dextrinoid chlamydospores, which are presumably referable to the host, *Hypochnicium vellereum*. Since the imperfect state of *Filobasidiella* Kwon-Chung is *Cryptococcus* Vuill., one would expect to obtain yeast-like cultures from the parasite, though it should be noted that *Filobasidiella depauperata* (Petch) Samson & al, recorded from scale insects in Norfolk, is also not known to produce a yeast-like anamorph (Samson & al, 1983). Germination of *F. lutea* basidiospores has not yet been seen.

Oberwinkler (*in litt.*) has noted the presence of small (2 - 3 µm) haustoria-like cells on some hyphae, bearing multiple short, tubular processes. Whether these interact with the host hyphae is unknown.



Figs. 3 & 4. ***Filobasidiella lutea:*** 3) immature and mature basidia [Roberts 355, K(M) 30401]; 4) basidia at hymenial surface [J. Weightman & A. Henrici, K(M) 18754].

PLATYGLOEALES

Achroomyces henricii P. Roberts sp. nov. (Fig. 5)

Etym.: named for the collector, Alick Henrici, who has discovered many unusual and interesting heterobasidiomycetes new to Britain.

Basidiomata inconspicua vel invisibilia licet observetur sine lente. *Hyphae* 2 - 3 µm latae, fibulatae. *Basidia* cylindracea, ter transeptata, 60 - 80 x 8 - 15 µm, stipitibus angustis usque 150 µm longis. *Basidiosporae* oblongae vel subcylindraceae, 21 - 23 x 10 - 11.5 µm.

In *Diatrypi disciformi*, Mickleham Downs, Surrey, Anglia, 24 May 1994, A. Henrici, **K(M) 33269**, holotypus.

Basidiome inconspicuous, not macroscopically visible in the type specimen. *Hyphae* narrow, 2 - 3 µm wide, with clamp connexions. *Conidiophores* none seen. *Basidia* 4-celled, tubular with lateral septa, the sporulating part ca. 60 - 80 x 8 - 15 µm, with highly extended narrow stalk up to 150 µm long. *Sterigmata* short, up to 8 µm long, produced laterally. *Basidiospores* large, oblong to subcylindrical (Q = 1.8 - 2.3), 21 - 23 x 10 - 11.5 µm, germination not seen.

Specimen examined: ENGLAND: SURREY, Mickleham Downs, on *Diatrype disciformis* on *Fagus* twig, 24 May 1994, A. Henrici, **K(M) 33269**, holotype.

The most noticeable feature of *Achroomyces henricii* is the large basidia with exceptionally long stalks, reminiscent of the genus *Naohidea* Oberw. but otherwise distinct. The type and only specimen has a number of irregularly swollen, clavate or tubular cells emerging directly from the hyphae (Fig. 5) which might possibly represent separate 'probasidia'. If this can be confirmed from further specimens, then the species would be referable to the genus *Helicogloea* Pat. For the moment, it is placed in the genus *Achroomyces* Bonord.

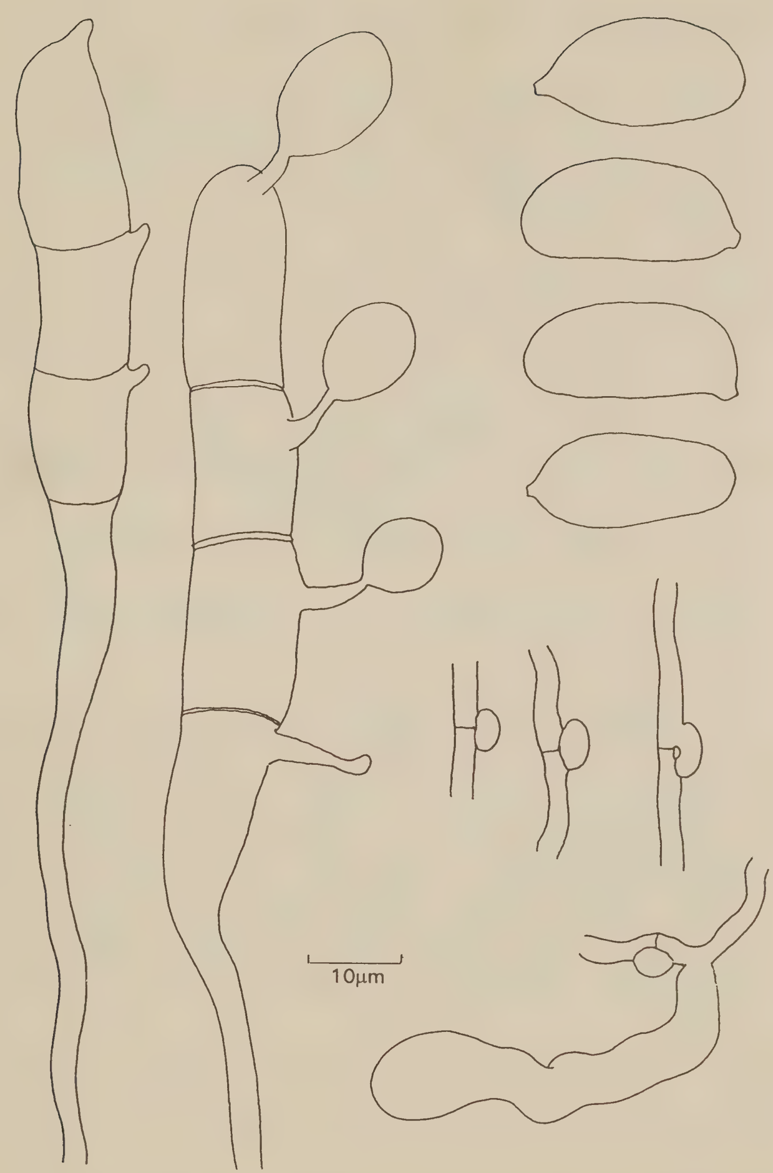


Fig. 5: ***Achroomyces henricii***: basidia, basidiospores, hyphae and probasidia-like outgrowth [A. Henrici, K(M) 33269, holotype].

Occultifur corticiorum P. Roberts sp. nov. (Fig. 6)

Basidiomata nulla, in hymeniis corticiorum parasitica. *Hyphae* 1.5 - 2.5 µm latae, non fibulatae, haustoria tremelloidea ferentes. *Conidiophora* clavata, 6 - 9 x 3 - 4 µm. *Conidia* ellipsoidea, 5 - 6 x 3.5 - 4.5 µm. *Basidia* cylindracea, ter transeptata, 45 - 60 x 2.5 x 5 µm. *Basidiosporae* ovoideae vel ellipsoideae, 5 - 7 x 4 - 4.5 µm.

In hymenio *Hyphodermatis praetermissi*, Slapton, Devon, Anglia, 10 Dec. 1994, P. Roberts 865, **K(M) 33238**, holotypus.

Basidiomes not macroscopically visible, hyphae and basidia occurring within the host hymenium. *Hyphae* narrow, 1.5 - 2.5 µm wide, hyaline, thin-walled, lacking clamp connexions; tremelloid haustorial cells present, clavate to ellipsoid, 2 - 3 µm wide, giving rise to thin, tendril-like outgrowths. *Conidiophores* clavate, 6 - 9 x 3 - 4 µm, arising singly or in clusters, apically budding off two or more conidia. *Conidia* ellipsoid, 5 -6 x 3.5 - 4.5 µm, with thickened, gelatinized walls. *Basidia* cylindrical, laterally septate, 4-celled, thin-walled, short-stalked, arising directly from the hyphae, 45 - 60 x 2.5 - 5 µm. *Sterigmata* sinuous, up to 15 µm long, possibly longer. *Basidiospores* ovoid to ellipsoid (Q = 1.2 - 1.6), 5 -7 x 4 - 4.5 µm from print, with wide apiculus, germination not seen.

Specimen examined: ENGLAND: DEVON, Slapton Wood, in hymenium of *Hyphoderma praetermissum* (P. Karst.) J. Erikss. & Strid, 10 Dec. 1994, P. Roberts 865, **K(M) 33238**, holotype.

This new species is tentatively assigned to the genus *Occultifur* Oberw. on the basis of its tremelloid haustorial cells and simple conidiophores. *Occultifur internus* (L.S. Olive) Oberw., the type and only other species of the genus, is a parasite of *Dacrymyces* Nees, possesses clamp connexions, and as yet has only been found in Britain in its conidial form.

Colacogloea peniophorae (Bourdot & Galzin) Oberw. & Bandoni also parasitizes *Hyphoderma praetermissum*, but lacks haustorial cells, possesses clamp connexions, and is otherwise distinct. It is a common species, at least in southern England, which initially appears in the hymenium of *H. praetermissum* and then gradually envelopes the host fruit body, producing pustular, gelatinous basidiocarps over the host remains.

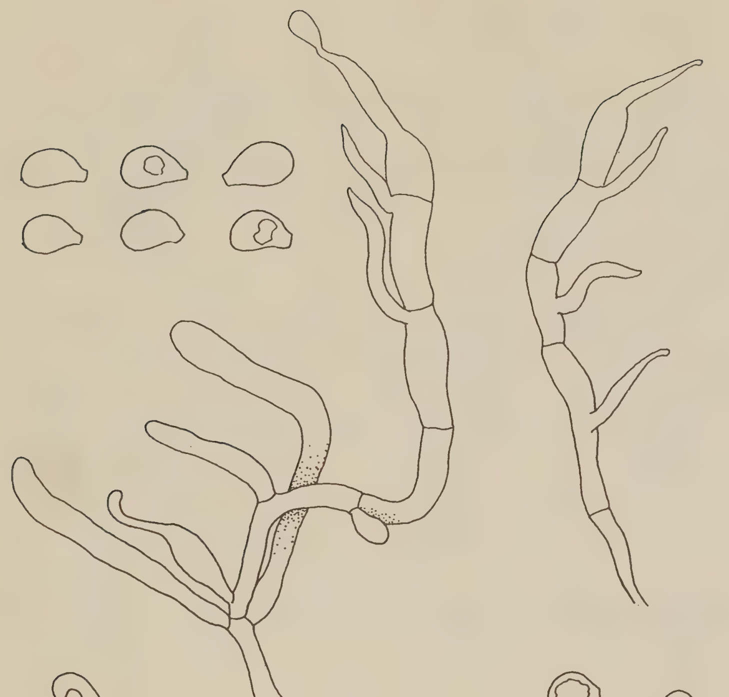


Fig. 6: ***Occultifur corticiorum***: basidiospores and basidia, hyphae with haustorial cells, conidia and conidiophores [Roberts 865, K(M) 33238, holotype].

Spiculogloea minuta P. Roberts sp.nov (Figs. 7 & 8)

Basidiomata nulla, in hymeniis fungorum parasitica. *Hyphae* angustae, 1 - 1.5 µm latae, fibulatae, haustoria tremelloidea ferentes. *Basidia* cylindracea, transeptata, e probasidiis parvis exorientia, 12 - 25 x 3 - 3.5 µm, plus minusve crassitunicata, cyanophila, subtiliter spiculata vel granulata. *Basidiosporae* anguste fusiformes (Q =3.6 - 6.6), (6.5-) 8.5 - 12 x 2 - 2.5 (-3) µm.

In hymenio *Tulasnellae violeae*, Great Plantation, Bovey Tracey, Devon, Anglia, P. Roberts 271, **K(M) 33218**, holotypus.

Basidiomes within host hymenia, not macroscopically visible. *Hyphae* very thin, 1 - 1.5 µm wide, with clamp connexions, sparsely present often as single strands, producing tremelloid haustorial cells subtended from clamp connexions, swollen at base, 1.5 - 2µm wide, giving rise to thin tendril-like outgrowths. *Basidia* spiculate, with distinctly thickened, cyanophilous walls, arising in clusters of 2 - 20, initially as ovoid probasidia, 2 - 3µm wide; mature basidia 12 - 25 x 3 - 3.5 um, arising apically from the probasidia which become +/- indistinct; aseptate or laterally septate, 1 - 4 celled. *Sterigmata* rarely seen, basidia often appearing aseptate and sterile; when seen, short, 1 - 2µm long. *Basidiospores* narrowly fusiform (Q = 3.6 - 6.6), (6.5-) 8.5 - 12 x 2 - 2.5 (-3) µm from prints, thin to thick-walled, occasionally producing secondary spores, germinating by germ tube, sometimes becoming 1-septate, very sparsely present in host spore prints.

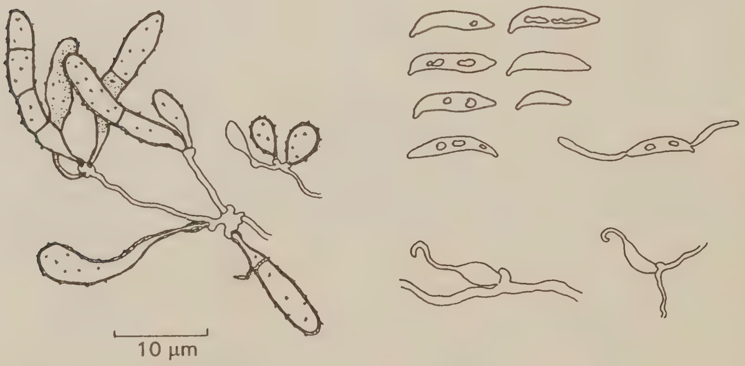


Fig. 7. ***Spiculogloea minuta***: basidia and probasidia, basidiospores (one germinating), hyphae and haustorial cells [Roberts 271, K(M) 33218, holotype].

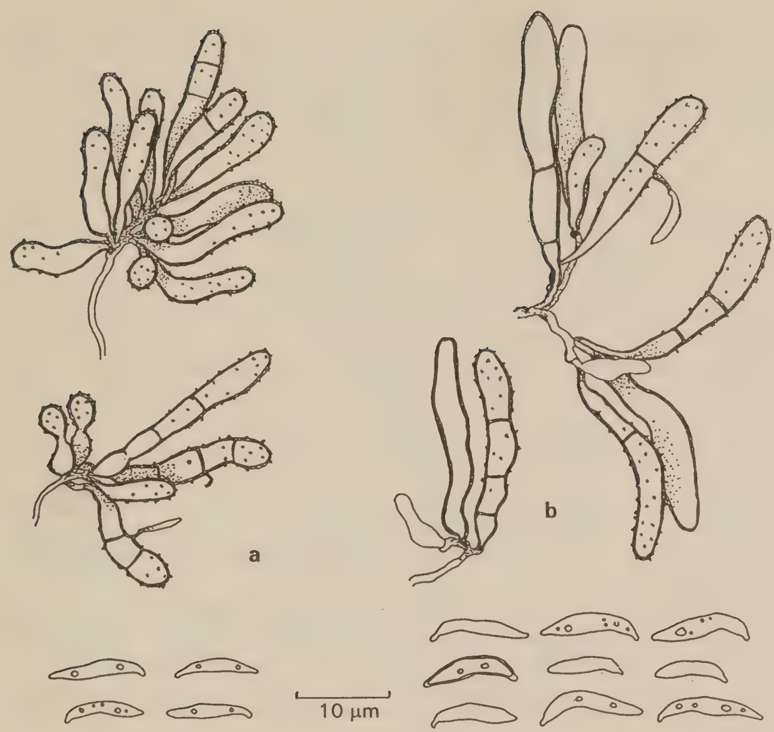


Fig. 8. ***Spiculogleoa minuta***: clustered basidia, basidiospores a) [Roberts 354, K(M) 33219]; b) [Roberts 287, K(M) 39495].

Specimens examined: ENGLAND: DEVON, Dartmoor, Bellever Forest, in hymenium of *Tubulicrinis accedens* (Bourdot & Galzin) Donk with *Serendipita evanescens* (Hauerslev) P. Roberts on decorticated *Picea* log, 7 Dec. 1991, P. Roberts 354, **K(M) 33219**; Bovey Tracey, Great Plantation, in or with *Tulasnella violea* (Quél.) Bourdot & Galzin on fallen *Salix* branch, 29 Jun. 1991, P. Roberts 271, **K(M) 33218**, holotype; same location, in or with *Tulasnella saveloides* P. Roberts on fallen *Salix* branch, 23 Mar 1991, P. Roberts 287, **K(M)39495**; Torquay, Watcombe Woods, in hymenium of *Helicogloea lagerheimii* Pat. on fallen trunk, probably *Ulmus*, 27 Jun. 1991, P. Roberts 277, **K(M) 33210**; SURREY, Esher Common, with *Tulasnella eichleriana* Bres., 4 Jun. 1995, P. Roberts, **K(M) 39193**.

The basidiospores of this inconspicuous species were first noticed as common, though sparse contaminants of *Tulasnella* J. Schröt. spore prints and only later traced to the basidial clusters occasionally seen in squash mounts of the hosts. Six more British *Tulasnella* collections (in addition to those cited above) have been noted as having similar spores

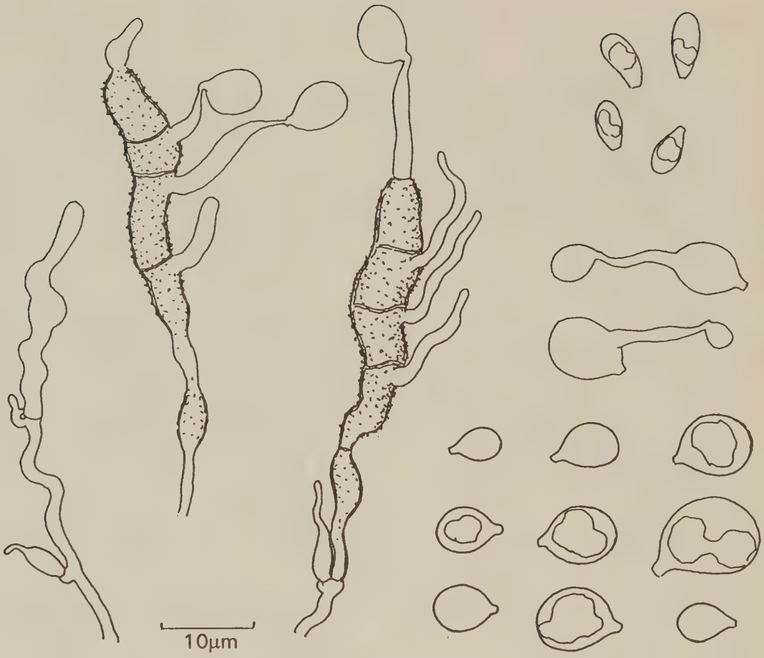


Fig. 9. ***Spiculogloea occulta***: basidia with probasidia and haustorial cells, conidia, basidiospores [Roberts 827, K(M) 33236].

present, although *Spiculogloea minuta* does not appear to be restricted to *Tulasnella*.

The unusual spiculate, thick-walled, cyanophilous basidia place this species in the genus *Spiculogloea* P. Roberts, recently described from Majorca (Roberts, 1996a) based on *S. occulta* P. Roberts, the type and only original specimen of which was found in the hymenium of *Hyphoderma praetermissum*. A second specimen (Fig. 9) has now been collected in England in the hymenium of *Hyphodontia sambuci* (Pers.) J. Erikss. (Howell Hill Nature Reserve, Ewell, Surrey, 30 Oct. 1994, P. Roberts 827, **K(M) 33236**).

Spiculogloea minuta has similar basidia to those of *S. occulta*, and both species possess narrow hyphae with clamp connexions and tremelloid haustorial cells. *S. occulta*, however, has conventional, rather long and sinuous auricularioid sterigmata producing subglobose spores (slightly fusiform in the type specimen, less so in the English collection); it also produces conidiophores and ellipsoid conidia, and is altogether more conspicuous a parasite within the host hymenium.

In *S. minuta,* most of the basidia appear sterile and often aseptate. In the few seen bearing spores, the sterigmata are unusually short and it is not clear how the spores (which appear to be ballistospores) are released from the host hymenium. The probasidia are often found loose in mounts and may possibly function as propagules.

Achroomyces sp. (Roberts 549) (Fig. 10)

Basidiomes not macroscopically visible. *Hyphae* sparsely present, thin, 0.5 - 1μm wide, with clamp connexions. *Basidia* thin-walled, smooth, arising in clusters of 6 - 7, 15 - 20 x 2 - 2.5 μm, consistently 2-celled, with distinct, narrow stalk up to 15 μm long. *Sterigmata* arising laterally, rather short, up to 5 μm long. *Basidiospores* narrowly fusiform (Q = 3.5 - 7), often suballantoid, (8-) 10 - 13 (-14) x 1.5 - 2 (-2.5) μm from print, sometimes producing secondary spores, germinating by germ tubes.

Specimen examined: ENGLAND: DEVON, Torquay, Watcombe Woods, near or with *Tulasnella* species and cf. *Colacogloea peniophorae* on dead attached *Rubus fruticosus* stem, 8 Dec. 1992, P. Roberts 549, **K(M) 30514**.

The collection above clearly represents an undescribed auricularioid species, but the material is inadequate for type purposes and hence is not formally described here. The narrow hyphae, clustered basidia, and fusiform spores suggest some affinity with *Spiculogloea*, but in this new

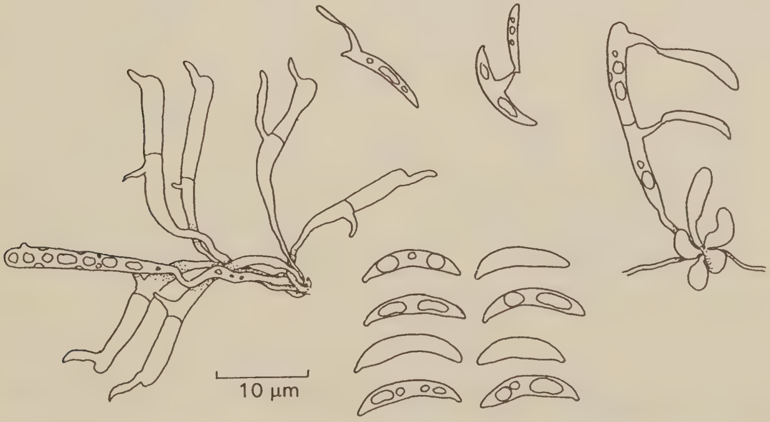


Fig. 10: ***Achroomyces sp.*** (Roberts 549): clustered basidia, basidiospores [K(M) 30514].

taxon the basidia are thin walled and smooth. No haustorial cells were seen, but the specimen is so meagre they could have been overlooked.

An existing two-spored species, *Achroomyces bispora* (Hauerslev) Hauerslev, described as an hymenial parasite of *Tubulicrinis angustus* (D.P. Rogers & Weresub) Donk, has spiralled basidia and is quite distinct (Hauerslev, 1987). A recent British collection tentatively referred to *A. bispora* (in hymenium of *Tubulicrinis subulatus* (Bourdot & Galzin) Donk on *Pinus*, Slapton Wood, Devon, 22 Jan. 1994, P. Roberts 828, **K(M) 30517**) differs from the type description in having 2 - 4 spored basidia and conspicuous, pustule-forming conidiophores (Fig. 11).

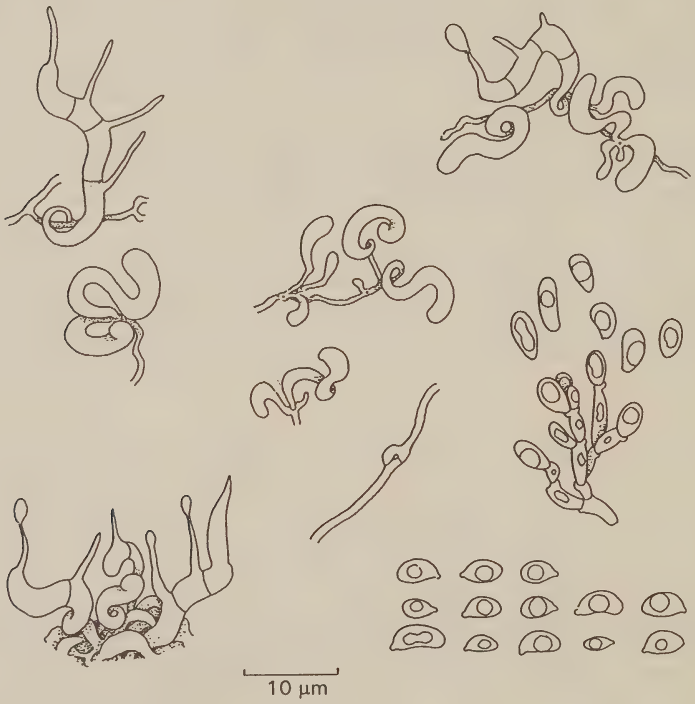


Fig. 11: ***Achroomyces* cf. *bispora***: spiralling basidia, conidia and conidiophores, basidiospores [Roberts 828, K(M) 30517].

Achroomyces sp. (Henrici 25.2.95) (Fig. 12)

Basidiome not macroscopically visible, in hymenium of poroid fungus. *Hyphae* 1 - 2.5 µm wide, with clamp connexions; no haustorial cells seen. *Conidiophores* simple, tubular, hypha-like, 8 - 20 µm long, arising alongside basidia. *Conidia* arising apically from the conidiophores as slighted curved, clavate, lateral outgrowths, 4 (-8?) per conidiophore; after

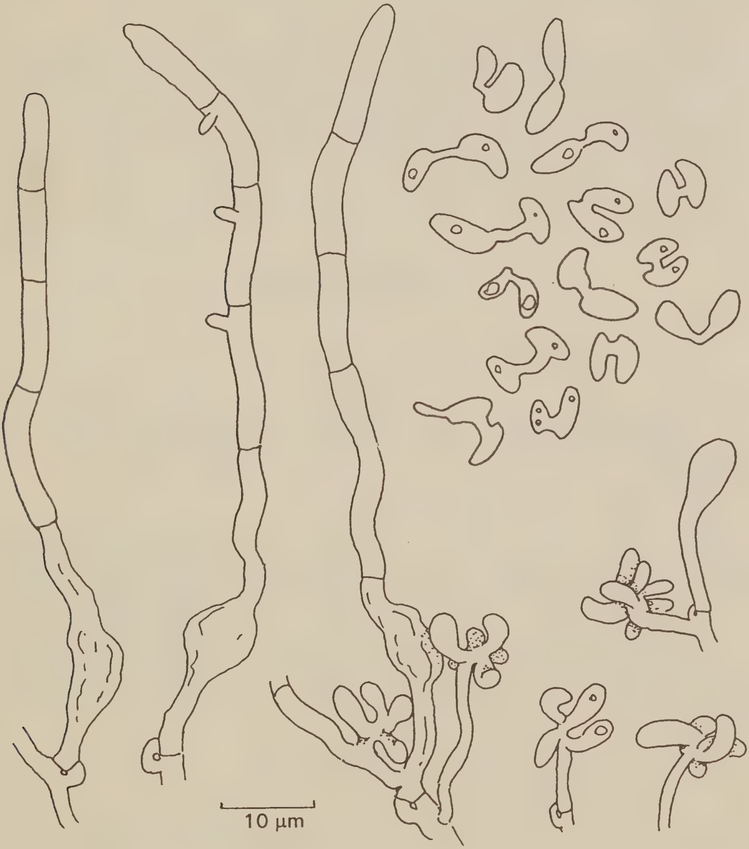


Fig. 12: ***Achroomyces*** **sp.** (Henrici 25.2.95): basidia, conidia, and conidiophores [K(M) 30534].

release, appearing as irregularly paired, variously yoked, ellipsoid to oblong conidia, each 3.5 - 7.5 x 1.5 -3 µm; the yoke is narrow, 0.5 - 4 µm long, and connects the conidia at irregular points; the yoked conidia are not necessarily of equal size. *Basidia* 4-celled, tubular, 70 - 85 x 2.5 - 3.5 µm, laterally septate, arising apically from subglobose to ellipsoid, stalked probasidia, visible as sub-basal swellings at maturity. *Sterigmata* not clearly seen. *Basidiospores* not seen.

Specimen examined: ENGLAND: SURREY, Mickleham Downs, in hymenium of *Antrodiella onychoides* (Egel.) Niemelä on fallen *Fagus* branch, 25 Feb. 1995, A. Henrici, **K(M) 30534**.

Although the specimen is sparse and information on basidiospores is lacking, this clearly represents a distinct taxon with an unusual host and very distinctive yoked conidia. *Zygogloea gemellipara* P. Roberts also produces yoked or twinned conidia, but they arise from paired cells and are of a very different form.

INCERTAE SEDIS

Heteromycophaga P. Roberts gen.nov.

Conidiomata nulla vel gallas gelatinosas efferentia, in fungis parasitica. *Hyphae* in typo generis tenuissimae, fibulatae. *Conidiophora* cylindracea, ramosa, conidia singulatim apicale efferentia. *Conidia* in typo generis clavata vel oblonga, 8 - 10 x 2.5 - 3.5 µm.

Typus generis: *Heteromycophaga glandulosae*

Conidiomata in host hymenium or fruitbody surfaces, forming gelatinous, pustular galls in the type species. *Hyphae* narrow, 1 - 2 µm wide in the type species, with clamp connexions, haustorial cells not seen. *Conidiophores* hypha-like, branched, producing single terminal conidia subtended from clamp connexions. *Conidia* weakly clavate to oblong in the type species, 8 - 10 x 2.5 - 3.5 µm, germinating to form yeast-like colonies.

Type species: Heteromycophaga glandulosae

Heteromycophaga glandulosae P.Roberts sp.nov. (Figs. 13 - 15)

Conidiomata nulla, parasitica, gallas gelatinosas in basidiomatibus *Exidiae glandulosae* efferentia. *Hyphae* tenuissimae, 1 - 2 µm latae, fibulatae. *Conidiophora* cylindracea, ramosa, conidia singulatim apicale efferentia. *Conidia* clavata vel oblonga, 8 - 10 x 2.5 - 3.5 µm.

In basidiomatibus *Exidiae glandulosae*, Scadson Woods, Torquay, Devon, Anglia, 25 Feb. 1995, P. Roberts 898, **K(M) 33197**, holotypus.

Conidiomata forming pallid, gelatinous, pustular galls, 1 - 3 mm diam., on the hymenium and undersurfaces of fruit bodies of *Exidia glandulosa* Bull. *Hyphae* 1 - 2 µm wide, hyaline, thin-walled, with clamp connexions; branched and irregular in the host context, causing irregular swellings of the host hyphae at points of interaction, up to 25 µm wide. *Conidiophores* tubular, branched, hypha-like, forming a dense layer at the gall surface, producing single terminal conidia subtended from clamp connexions; subterminal hyphae 12 - 20 µm long. *Conidia* weakly clavate to oblong, 8-10 x 2.5 - 3.5 µm, sometimes appearing broadly apiculate, occasionally with remains of subtending clamp connexion attached, germinating to form yeast-like colonies.

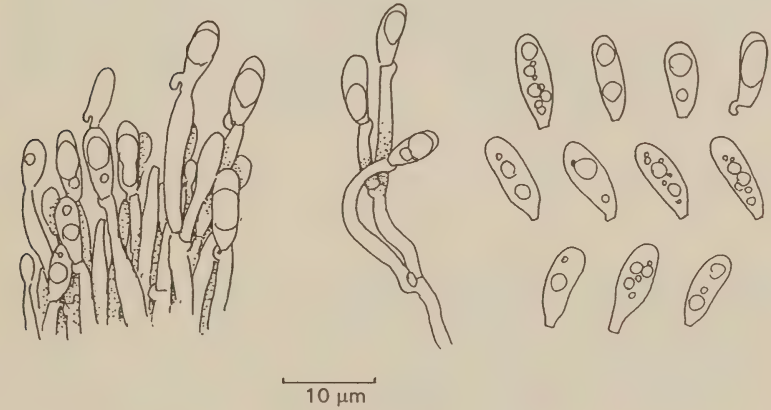


Fig. 13: ***Heteromycophaga glandulosae***: section of gall surface, conidiophore, conidia [Roberts 897, K(M) 33195].

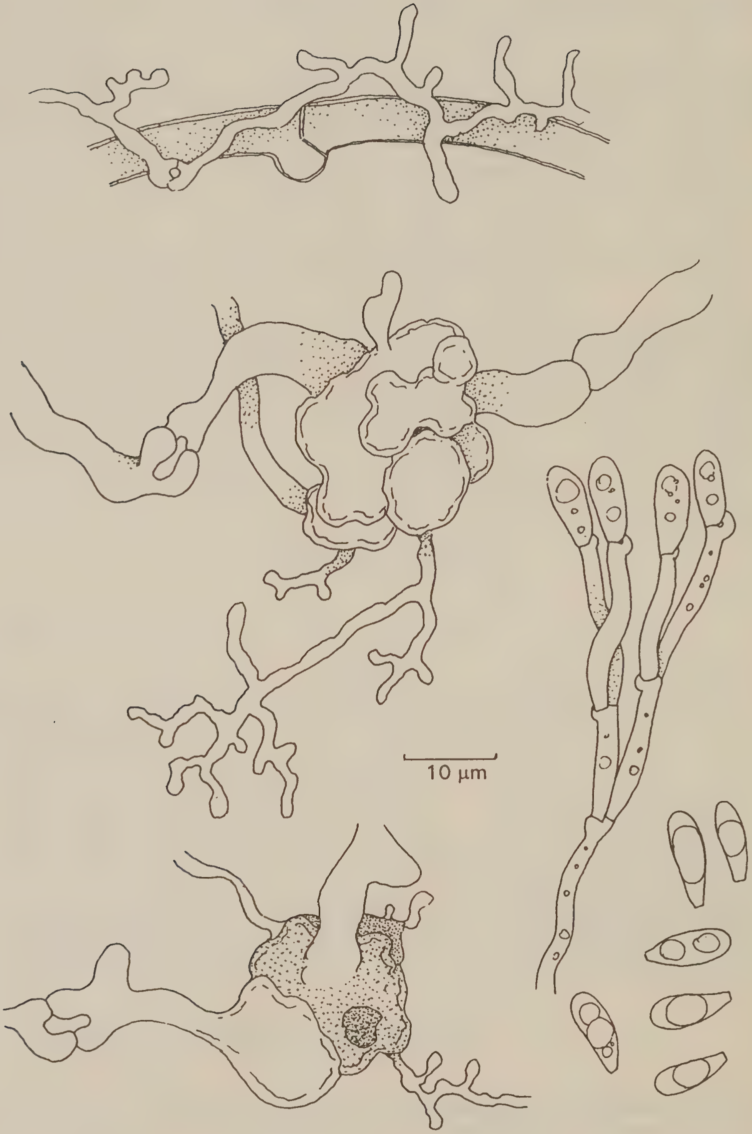


Fig. 14: ***Heteromycophaga glandulosae***: hyphae and host hypha, swollen distorted cells at presumed points of contact between host and parasite hyphae, conidiophores and conidia [Roberts 898, K(M) 33197].

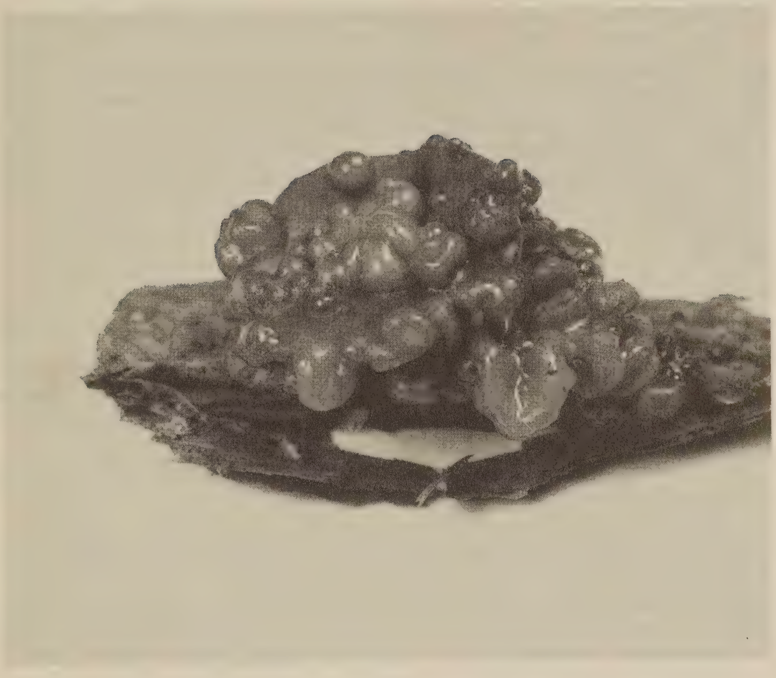


Fig. 15. ***Heteromycophaga glandulosae***: galls on parasitized fruit body of *Exidia glandulosa* [photo: Andrew McRobb, RBG, Kew].

Specimens examined (all on fruit bodies of *Exidia glandulosa*): ENGLAND: DEVON, Torquay, Scadson Woods, on attached *Quercus* branch, 18 Dec. 1993, P. Roberts, K(M) 33181; same location and substrate, 29 Dec. 1994, P. Roberts, **K(M) 33194**; same location and substrate, 25 Feb. 1995, P. Roberts 898, **K(M) 33197**, holotype; SURREY, Esher, West End Common, same substrate, 24 Jan. 1995, P. Roberts 897, **K(M) 33195**; same location and substrate, 5 Feb. 1995, B.M. Spooner, **K(M) 33196**.

The presence of clamp connexions together with a yeast-like state indicate that this gall-forming parasite is heterobasidiomycetous, but no perfect state could be found in any of the collections cited above and its affinities are unclear. A new anamorphic genus, *Heteromycophaga*, is required to accommodate the species.

The galls (Fig 15) range from pallid, pustular swellings to quite distinct subglobose outgrowths and are composed of both host and parasite hyphae. They appear on any part of the fruit body, sometimes taking over small or young fruit bodies completely. No haustorial cells could be found on the hyphae, though similarities between host and parasite hyphae make them difficult to differentiate. However, clumps of swollen, distorted cells frequently appear in the subhymenium associated with narrow branching hyphae (Fig 14). These are presumed to be points of contact between parasite and host. A yeast stage was formed in culture which initially produced some short hyphal growth with clamp connexions, but subsequently regressed to a simple yeast stage and expired.

Hormomyces peniophorae P. Roberts sp. nov. (Fig. 16)

Conidiomata pustulata, gelatinosa, hyalina, usque 1 mm lata, in hymeniis *Peniophorae* parasitica. *Hyphae* 1.5 - 2.5 µm latae, non fibulatae, haustoria tremelloidea ferentes. *Conidiophora* tubulata, 10-15 µm longa. *Conidia* ellipsoidea, 4 - 5 x 2.5 - 3 µm.

In hymenio *Peniophorae lycii*, Scadson Woods, Torquay, Devon, Anglia, 21 Jan. 1996, P. Roberts 907, **K(M) 33706**, holotypus.

Conidiomata pustular, smooth, gelatinous, sordid hyaline, up to 1 mm diam., arising from host hymenia. *Hyphae* thin to thick-walled, 1.5 - 2.5 µm wide but in places short-celled and swollen up to 7 µm wide, lacking clamp connexions, giving rise to abundant haustorial cells, these clavate to irregularly swollen, 1.5 - 2.5 µm wide, with thin tendril-like outgrowths; hyphae found throughout the host hymenia. *Conidiophores* simple, tubular or somewhat swollen, 10 - 15 µm long, arising singly or in clusters, producing 2 - 4 conidia apically. *Conidia* ellipsoid, 4 - 5 x 2.5 - 3 µm.

Specimens examined: ENGLAND: DEVON, Slapton Wood, in hymenium of *Peniophora lycii* (Pers.) Höhn. & Litsch. on *Ulmus*, 10 Dec. 1994, P. Roberts 711, **K(M) 33198**; Torquay, Scadson Woods, in hymenium of *P. lycii* on *Rubus idaeus*, 21 Jan. 1996, P. Roberts 907, **K(M) 33706**, holotype.

Though lacking clamp connexions, the tremelloid haustorial cells indicate that this hymenial parasite is a heterobasidiomycete, here provisionally referred to *Hormomyces* Bonord., the type of which is the conidial anamorph state of *Tremella mesenterica* Retz. (*fide* Donk, 1966). Despite a search, no basidia or basidiospores could be found in either collection and spore prints contained only host basidiospores. It is just possible, however, that the 'conidiophores' represent simple, *Chionosphaera*-like basidia.

A known hymenial parasite of *Peniophora* species is *Tremella versicolor* Berk. & Broome, but its hyphae possess clamp connexions and its conidiophores (which occur together with the basidia) are quite different. It has recently been extensively redescribed and studied by Bandoni & Ginns (1993). The conidiophores of *H. peniophorae* are distinctive, and do not closely resemble those of any other mycoparasitic heterobasidiomycete. The haustorial cells are often terminal, a feature of the genus *Sirotrema* Bandoni, proposed as a segregate of *Tremella* (Bandoni, 1986). However, the affinities of *H. peniophorae* remain at present unknown.

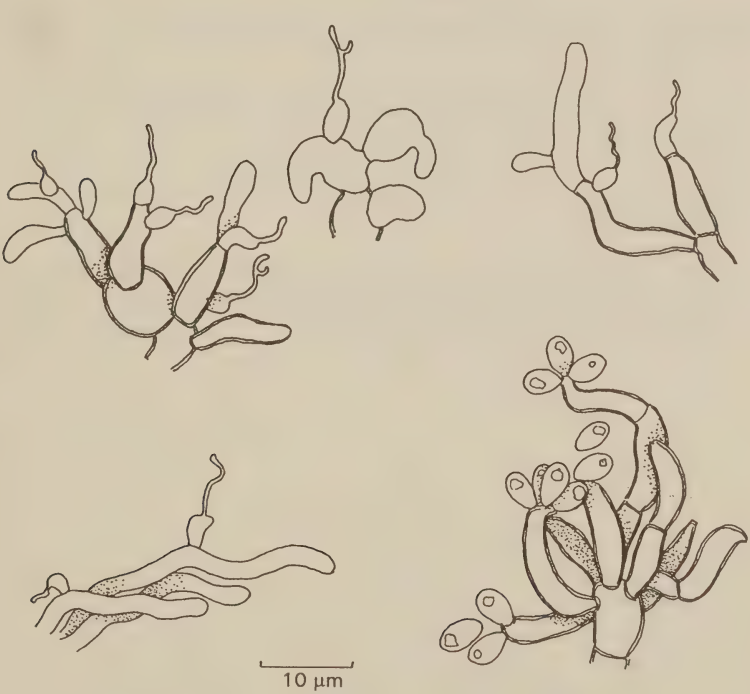


Fig. 16: ***Hormomyces peniophorae***: hyphae showing haustorial cells, conidiophores and conidia [Roberts 711, K(M) 33198].

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REFERENCES

Bandoni, R.J. (1986) *Sirotrema*: a new genus in the *Tremellaceae. Can. J. Bot.* 64: 668-676

Bandoni, R.J. & Ginns, J. (1993) On some species of *Tremella* associated with *Corticiaceae. Trans. Mycol. Soc. Japan* 34: 21-36

Diederich, P. (1996) The lichenicolous heterobasidiomycetes. *Bibl. Lichenologica* 61: 198 pp.

Donk, M.A. (1966) Check list of European hymenomycetous *Heterobasidiae. Persoonia* 4: 145-335

Hauerslev, K. (1987) New species and notes on resupinate fungi. *Friesia* 11: 329-336

Roberts, P. (1996) Heterobasidiomycetes from Majorca & Cabrera. *Mycotaxon* 60: 111-123

Samson, R.A., Stalpers, J.A., & Weijman, A.C.M. (1983) On the taxonomy of the entomogenous fungus *Filobasidiella arachnophila. Antonie van Leeuwenhoek* 49: 447-456

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TUBER PSEUDOHIMALAYENSE sp. nov. AN ASIATIC SPECIES COMMERCIALIZED IN SPAIN, SIMILAR TO THE "PERIGORD" TRUFFLE

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Abstract: A *Tuber* species from Asia and commercialized in Spain has been subjected to study. *Tuber pseudohimalayense* is proposed as a new species, and some optic and electronic microscope photographs are supplied. A comparison with the type material of *T. himalayense* is also provided.

Key words: *Tuber pseudohimalayense, T. himalayense,* Taxonomy, Truffle market, Legislation, Spain.

INTRODUCTION

In the truffle market, three sectors can be clearly defined: The producers, the transformers (dealers or handlers) and the consumer-countries. For many years, the main producers have been France, Italy, Spain, Yugoslavia and Tunisia (commercialized the desert fungus, *Terfezia* sp.). As far as the handlers (canneries and specialized food processing) are concerned the most important countries are France, Italy, Spain, Switzerland, Holland, Germany and United States. The main consumers, cited at random, are: France, Italy, Germany, Canada, Spain, United States, Belgium, Luxembourg, Great Britain, Denmark, Greece, Switzerland, Austria, Japan, Hong Kong, Australia, Sweden, Norway, Finland, Republic of South Africa, Venezuela, Zambia and China

(Ciani, 1992; Ciani & al., 1992). Furthermore, the list of producers is steadily growing as indicated by numerous imports from the Asian continent. This trend has been observed by the authors in Italy, France and Spain.

Importation of a great quantity of exotic fungi could have a negative effect on the canning industry and truffle breeding. Truffle breeding is mentioned because of the possible substitution (for economical reasons) of cheaper fruitbody varieties and the impact it may have on the production of mychorrizal plants. For these reasons, it becomes indispensable to elaborate updated legislation, if possible at the level of the European Union, that would encompass current changes. A first step is to study the taxonomy of the fungi involved. This report examines the taxonomy of a *Tuber* species from Asia that has been commercialized in Spain.

MATERIAL AND METHODS

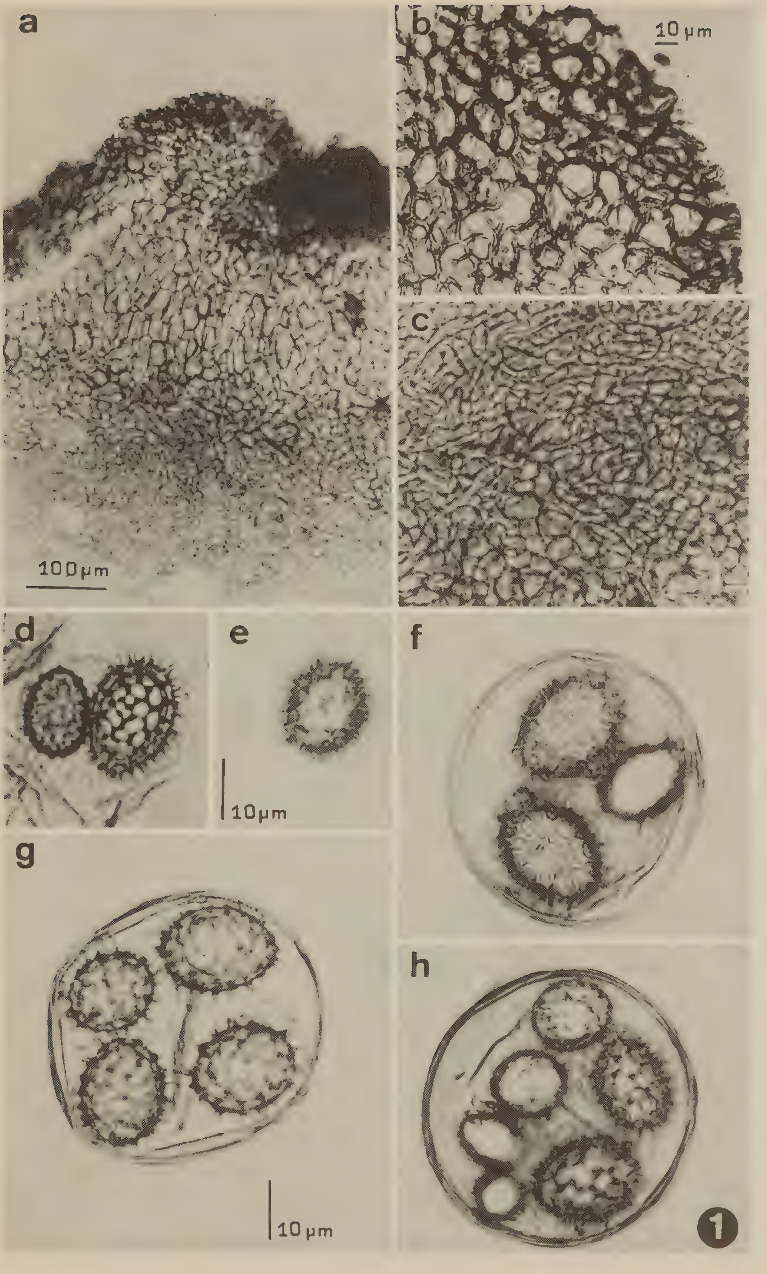
The fungus sample described here, was provided by donation from an industry dedicated to the truffle commercialization in Spain, and it is preserved in the herbarium of the University of Alcalá (AH).

The SEM photographs have been taken with a Zeiss DSM-950 microscope. Spore samples were rehydrated with 100% ammonium hydroxide for 30 min, then dehydrated in aqueous ethanol solutions (70%) for 1-1.5 h, before fixation in formaldehyde dimetilacetal, (after inmmersion in acetone for at least 2 h). The spores were subsequently dried to a critical point, mounted onto an aluminium stub, and coated with gold-palladium in a Polaron E-5000 sputter coater for 120 sec at 1.4 kV and 18 mA (argon atmosphere) to create a metal coating, approximately 500 Å thick. Light microscopy (LM) photos were taken with a Nikon Labophot microscope equipped with an automatic photographic system.

***Tuber pseudohimalayense* G. Moreno, Manjón, Díez & García-Montero, sp. *nov.* (Figs. 1-2)**

Etymology: *pseudohimalayense* due to their great resemblance with *Tuber himalayense*.

Figs. 1.- *T. pseudohimalayense* AH 18331 *Typus:* a, detail of the external covering of the peridium; b, thick-walled globose cells of the external covering of the peridio; c, plectenchymal cells of the internal covering of the peridium; d, globose ascus with 2 ascospores, where the espinous-reticular ornamentation is apparent; e, detail of the thorny spore ornamentation; f, ascus with 3 ascospores; g, ascus with 4 ascospores; h, ascus with numerous ascospores.


a
b
10 µm
c
100 µm
d
e
10 µm
f
g
10 µm
h
1

Diagnosis: *Ascocarpus* 2 cm *latus. Peridium bistratosus. Excipulum externus latus cum verrucae, cellulis globosis* 10-35 µm *diám (textura angularis), rufo-brunneus, crassitunicatis,.* 200-500 µm, *crass, praecique cellulis externis; excipuluminternum.* 100-250 µm, *crass (textura intricata), hyphis filamentosis intricatis* 7-9 µm *diam., hyalinis. Asci globosis* 55-65 µm diam., *sine stipes*, 1-7 *ascosporis. Ascosporis ellipsoideis.* 18-35 x 16-30 µm, *interconnexis in reticulo multi maculatis, sed homogeneis in total superficie. Typus: forsam ad Sinam collecti,* I-1995, *in* AH 18331 *conservatus est.*

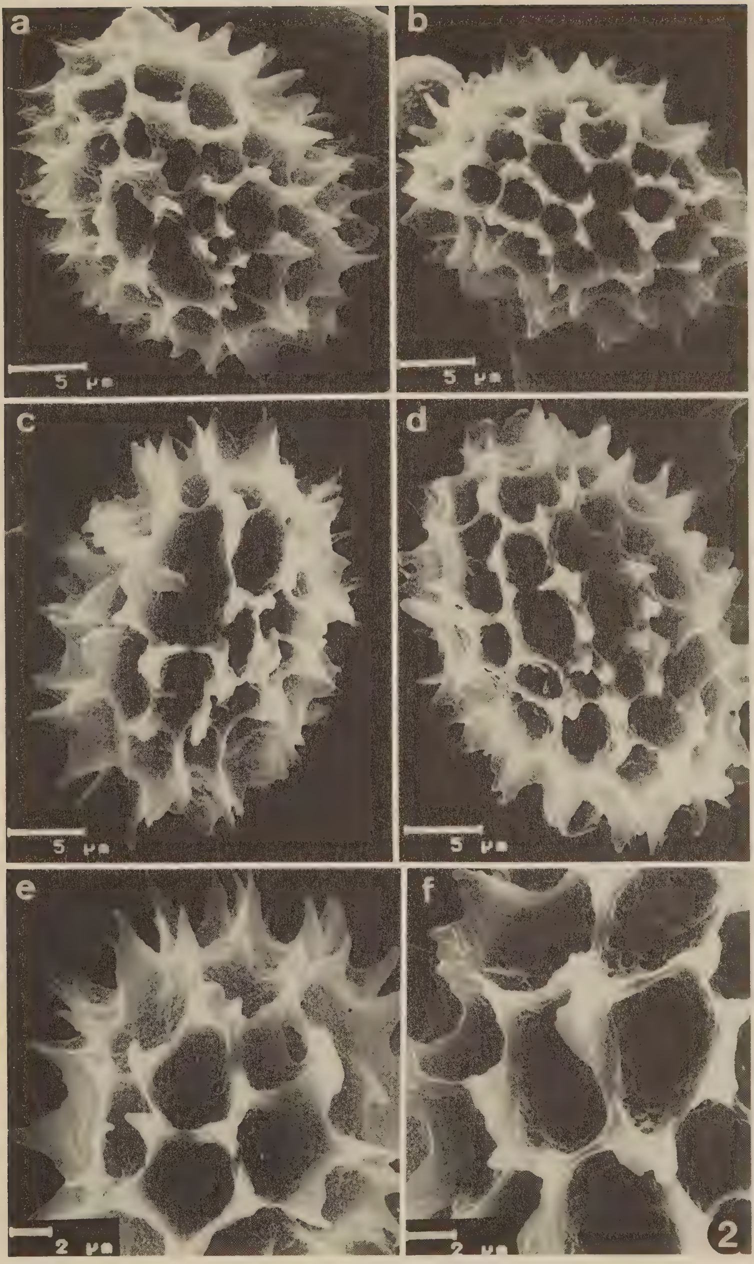
Specimens studied: *Tuber pseudohimalayense.* Probably imported from China, in January of 1995. **AH 18331 Holotypus.** *Tuber himalayense isotypus* AH 18383.

Ascocarp subglobose of 2 cm broad. Peridium with more or less pyramidal wide black and flat warts. Gleba gray-blackish in the maturity, composed of thin whitish and interwoven venae distributed at random. Soft odour in the studied material.

Peridium comprising a distinct outer and inner layers. The outer excipulum, 200-500 µm broad including the warts, formed by globose cells, 10-35 µm of diám. (textura angularis), brown reddish colour, thick wall, 1-3 µm of width, mainly in the most external cells (Figs. 1a-b); the inner excipulum, 100-250 µm broad (texture intricata), composed by filamentous interwoven hyphae, 7-9 µm of width and hyaline (Fig. 1c);. Asci globulosa, 55-65 µm size, non peduculated, with 1-7 ascospores (Figs. 1d-h). Ascospores ellipsoid, 18-35 x 16-30 µm (including the ornamentation), 34-35 x 25-30 µm (in 1 spore asci), 30-34 x 22-30 µm (in 2 spores asci), and very variable in 3-4-5-6-7 spores asci enhanced by the presence of minor ascospores of possibly miscarried material. Ascospores brown colour to brown-blackish, with very patent ornamentation, composed of spines with broad basal connections which form a very netted reticulum formed of variable meshes (Figs. 1d-h), but homogeneous in all the sporal surface. This above mentioned ornamentation is shown in the S.E.M. photographs (Figs. 2a-f).

Observations: We conserve in our herbarium just one ascocarp, but due to its macro and microscopic peculiarities we propose to consider it a new species, yet with reservation since, at present time it was impossible to obtain new collections. Among the reasons which warrant our claim is the fact that the fungus is geographically distinct and little is known about its ecological requirements.

Figs. 2.- ***T. pseudohimalayense*** **AH 18331** ***Typus:*** a-d, spores thorny reticulations under the S. E. M.; e-f, detail of the sporal ornamentation under the M. E. B.


a
5 μm
b
5 μm
c
5 μm
d
5 μm
e
2 μm
f
2 μm
2

The new species is mainly characterized by its peculiar reticulated-spiny spores and for its macroscopical resemblance to the “Perigord” truffle. It could also be confused with *Tuber himalayense, T. indicum, T. melanosporum* and *T. spinoreticulatum*. The thick-walled spore and dark brown colour of the new species is also quite unique.

Tuber himalayense is a species known at the present just by its occurence in India, (Uttar Pradesh, Mussoorie) associated with *Quercus incana* (Zhang & Minter, 1988). It is characterized by an exoperidium with flat warts, grey coloured gleba and very variable ascospores with a different types of ornamentation, mostly reticulate with free spines interwoven into the mesh; spores predominantly spiny, tending to form a reticulation (Zhang & Minter, 1988). The ornamentation which they exibit at the sporal poles, with some protruberances in a form of suction pads or typical funnels under the optic microscope,(Figs. 3a-b) and the S.E.M. (Figs. 3c-g), is their most characteristic feature.

Tuber melanosporum differs in the pyramidal warts of the exoperidium, dark gleba and ascospore ornamentation formed by narrow and tight free spines (Parguey-Leduc & al., 1987; Granetti & al., 1990) while *T. indicum* presents darker spores, black and spiny but wide at the base (Manjón & al., 1995).

Tuber spinoreticulatum Uecker & Burdsall originated in U.S.A., is closely related to by the spiny-reticulated spores, but differs mostly in leathery ascocarps and peduculated asci (Uecker & Burdsall, 1977).

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My appreciation to Francesco Meotto, Centro di Studio sullo Micologia del Terreno C.N.R. de Torino (Italy), for facilitating a small herbarium sample of

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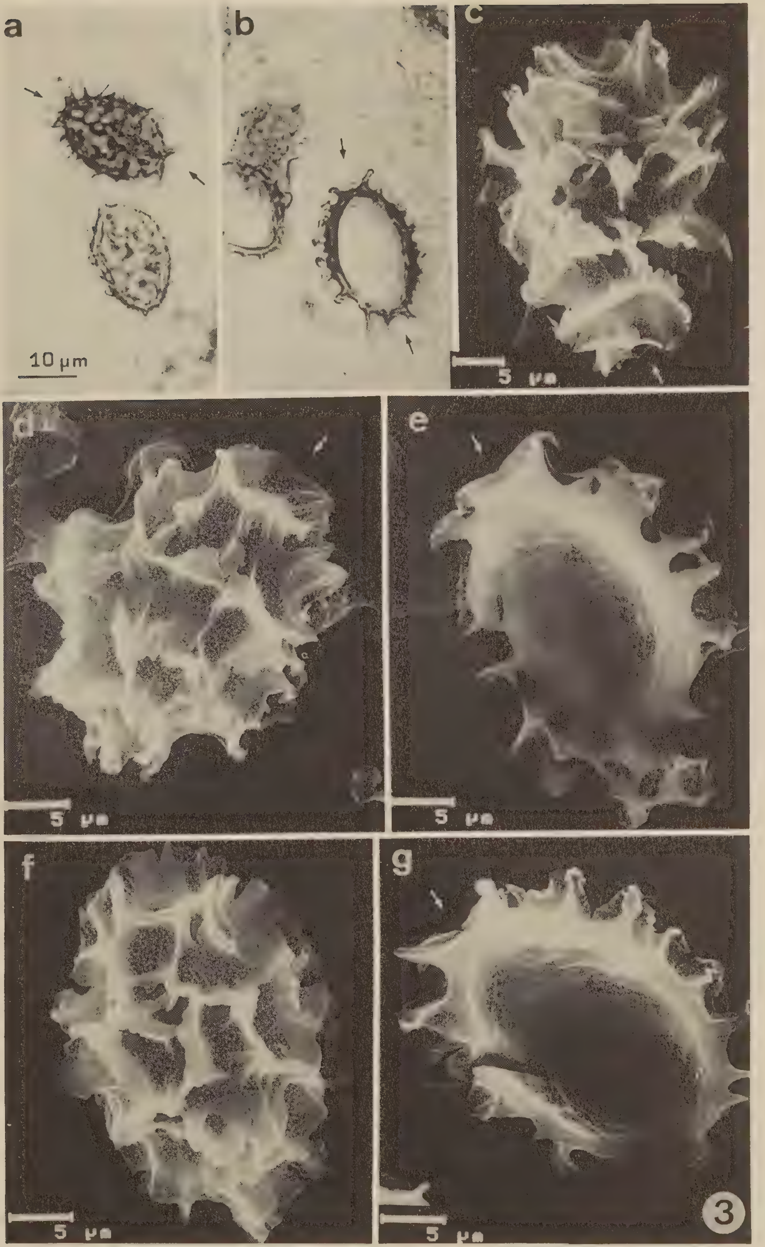
Figs. 3.- *Tuber himalayense* AH 18383 *Isotypus:* a-b, reticulated spores and sporal section; c-f, detail of the sporal ornamentation under the M. E. B.; g, sporal section.


a
b
c
d
e
f
g
10 µm
5 µm
5 µm
5 µm
5 µm
5 µm

3

Tuber himalayense isotypus, which was necessary to conduct the electronic microscopy scanning study.

Finally, we wish to acknowledge that this work have been sponsored by the INIA Project of (SC94-129), by the DGICYT Project of (PB91-0165) and by the Fundación Caja de Madrid.

LITERATURE

CIANI, A. (1992) - Il ruolo dela tartuficoltura nela strategia di rivitalizazione delle aree interne della C.E.E. *Micol. Veg. Medit.* 7: 349-384.

CIANI, A., B. GRANETTI & D. VINCENTI (1992) - Il tartufo in Italia e nel mondo: aree di produzione, mercato e prezzi. *L'Informatore Agrario* 47: 51-62.

GRANETTI, B, G. MINCIGRUCCI & E. BRICCHI (1990) - Analisi biometrica e morfologica delle ascospore di alcune specie del genere *Tuber. Atti del Secondo Congresso Internazionale sul Tartufo.* Spoleto, 24-27 novembre 1988. Comunità Montana de Monti Martani e del Serano, Spoleto.

MANJÓN, J. L., G. MORENO, J. DÍEZ & L. G. GARCÍA-MONTERO (1995) - *Tuber indicum* Cooke & Massee en España: Una especie comercializada con características similares a nuestra trufa negra. *Bol. Soc. Micol. Madrid* 20: 301-304.

PARGUEY-LEDUC, A., M. C. JANES-FAVRE & C. MONTANT (1987) - Formation et évolution des ascospores de *Tuber melanosporum*, trufle noire du Perigord, Discomycetes. *Canad. J. Bot.* 65: 1491-1503.

UECKER, F. A. & H. H. BURDSALL (1977) - *Tuber spinoreticulatum*, a new truffle from Maryland. *Mycologia* 69: 626-630.

ZHANG, B.C. & D. W. MINTER (1988) - *Tuber himalayense* sp. nov. with notes on Himalayan truffles. *Trans. Br. mycol. Soc.* 91(4): 593-597.

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MATING SYSTEMS IN HYMENOMYCETES: NEW REPORTS AND TAXONOMIC IMPLICATIONS

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ABSTRACT

Mating systems are reported for the following members of the Aphyllophorales and Agaricales: *Cheimonophyllum candidissimum*, *Collybia confluens*, *Gloiodon strigosum*, *Hypsizygus tessulatus*, *Lentinellus castoreus*, *Marasmiellus candidus*, *M. rameales*, *M. stenophyllus*, *Marasmius epiphyllus*, *Mycena aurantiomarginata*, *M. rosella*, *Omphalotus illudens*, *O. olivascens*, *Phyllotopsis nidulans*, and *Steccherinum basibadium*, all of which are tetrapolar. Observations are presented on the life cycle of *Marasmius minutus*, although its mating system remains unknown. In each case, a report of a definable mating system adds data to emerging patterns at generic and suprageneric levels.

Key words: mating systems, Hymenomycetes, Agaricales, Aphyllophorales.

INTRODUCTION

Data on mating systems (of any organisms) furnish information useful to systematics in at least three ways: 1) definition of "species concepts" has recently made its way from the technical/philosophical literature into semipopular journals (i.e. Davis, 1996), with one major construct being the "biological species;" 2) regardless of the criteria which undergird various "species concepts," it is critical to know whether individuals or representatives of populations can interbreed, and mating systems, together with understanding of the barriers to interbreeding (viz. Morell, 1996) are integral to that experimental process; and 3) mating systems (i.e. amphithallic, bipolar, tetrapolar) are just as valid as taxonomic characters as morphological (i.e. presence or absence of clamp connections, etc.) or biochemical (i.e. production or lack of unique secondary metabolites). Recent papers (see Petersen, 1995a, b, for references) have introduced "biological species" and "intersterility groups" into the lexicon of systematics of basidiomycetous fungi, but the foundation of these ideas is mating systems of individual taxa.

This report is the latest in a series (Petersen, 1992a, b, c; 1995a, b; Petersen and Gordon, 1994; Gordon and Petersen, 1991, 1992; Gordon et al., 1994) in which mating systems of Hymenomycetes have been reported for the first time. As such reports continue, patterns of supraspecific mating system consistency (Gordon et al., 1994; Petersen, 1995b) become clearer, and insight into speciation processes and species concepts are elaborated (Petersen, 1977; Petersen and Methven, 1994; Petersen and Halling, 1993; Petersen and Cifuentes, 1994). Such observations are included below under each species.

MATERIALS AND METHODS

Techniques for establishment of single-basidiospore isolates (SBIs) followed those by Gordon and Petersen (1991). In all cases, SBIs were screened for absence or presence of clamp connections (the latter constituting circumstantial evidence of dikaryotic condition) before inclusion in self-cross experiments. In this paper, the term "compatible" (opposite, incompatible) refers only to dikaryotization as evidenced by formation of clamp connections or dikaryotic condition as viewed under epifluorescence microscopy using DAPI. Fertility (used interchangeably with compatibility by some authors) is restricted to formation of basidiomata and viable basidiospores by compatible crosses, and is not the subject of this paper. The term "intercompatible" (opposite, interINcompatible) is reserved for intercollection matings in which clamp connections were observed (i.e., under Gloiodon strigosum).

In citations of specimens used, the first number listed is a field notebook number also used to track cultures (monokaryon and dikaryon), while the TENN number is the herbarium accession number of the voucher dried basidiomata. RHP is abbreviation of the author's name. In all cases,

	A_1B_2		A_2B_1				A_2B_2	A_1B_1				?
	12	3	4	2	7	9	14	15	1	5	10	13
12		–	+	+	+	+	–	–	–	–	–	–
3	–		+	+	+	+	F	–	F	–	–	–
4	+	+		–	–	–	–	–	–	–	–	F
2	+	+	–		–	–	–	F	–	–	–	–
7	+	+	–	–		–	–	F	–	–	–	F
9	+	+	–	–	–		–	F	–	–	–	F
14	–	F	–	–	–	–		+	+	+	+	–
15	–	–	–	F	F	F	+		–	–	–	F
1	–	F	–	–	–	–	+	–		–	–	–
5	–	–	–	–	–	–	+	–	–		–	–
10	–	–	–	–	F	–	+	–	–	–		–
13	–	–	F	–	F	F	–	F	–	–	–	

Fig. 1. Self-cross pairings for Cheimonophyllum candidissimum, 7463 (Finland).

Symbols for figures 1-4, 6-16: large + = compatible pairing, with abundant clamp connections on all hyphae; small + = few, scattered clamp connections, often only on agar-surface hyphae; - = incompatible pairings, with no clamp connections observed; large F = well-defined "flat" contact zone morphology indicative of common-A pairing, often accompanied by lethal reactions; small F = ill-defined "flat" contact zone morphology, usually without lethal reactions; large B = "barrage" contact zone morphology indicative of common-B pairing; small B = ill-defined "barrage" contact zone morphology; L = lethal reactions in contact zone, with significant lysis of donor hyphae; X = donor colonies did not make contact during experimental time period.

dikaryon (polyspore) and SBIs reside in the culture collection at TENN. In text assigning mating types, an * indicates a tester strain to represent that mating type in subsequent experiments.

RESULTS

Cheimonophyllum candidissimum (B & C) Singer

Specimen used: FINLAND, Etelä-Häme prov., Lammi, Biological Station, 12.IX.94, coll. RHP, on hardwood branches, no. 7463 (TENN no. 53588).

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 1). Isolates 1*, 5, 10, 15 = A_1B_1; 14* = A_2B_2; 3* 12 = A_1B_2; 2*, 4, 7, 9 = A_2B_1. Isolate 13 did not dikaryotize any mate, and its mating type remains unknown. Because barrage reactions were not observed, and because flat reactions were not patterned, subordinate mating types were assigned arbitrarily.

Culture characteristics: Hyphae at the agar surface commonly formed a "picket fence" branching pattern, with short, upright branches and diverticulate complexes. When these were abundant enough, the colony took on a minutely granular appearance.

Commentary: In the field, Cheimonophyllum candidissimum is easily mistaken for Panellus mitis (Pers.F Fr.) Singer, as both produce milk-white, small, pleurotoid basidiomata. Cheimonophyllum produces spherical, inamyloid basidiospores, non-gelatinizing pileus trama, and fruits on hardwoods, while P. mitis produces cylindrical to subreniform, weakly amyloid basidiospores, exhibits gelatinizing hyphal walls in the upper pileus trama, and fruits on conifer wood. A tetrapolar mating system for P. mitis has been reported elsewhere (Petersen & Gordon, 1994).

Collybia confluens (Pers.: Fr.) Kummer

Specimen used: UNITED STATES, North Carolina, Macon Co., Shortoff Mt. Trail, 18.vii.94, coll. J. Johnson, no. 7219 (TENN no. 53522).

Mating system: When 12 single-basidiospore isolates were paired in all combinations, a tetrapolar mating system was revealed (Fig. 2). Isolates 6*, 7 = A_1B_1; 8*, 9, 12 = A_22B_2; 5*, 10 = A_1B_2; 4*, 11, 13, 14, 15 = A_2B_1.

Flat contact zone reactions were well-defined, with narrow, equal crevasse, often coupled with lethal reactions. Barrage reaction was observed as an obscure, submerged, transecting line of somewhat congested mycelium. Many

	A_1B_1		A_2B_2			A_2B_1					A_1B_2	
	6	7	8	9	12	13	4	11	14	15	10	5
6		F	+	+	+	F	B	F	–	–	–	F
7	F		+	+	+	–	F	–	F	F	F	F
8	+	+		–	F	–	F	–	–	–	F	F
9	+	+	–		–	–	+	F	–	–	–	–
12	+	+	F	–		+	–	F	–	–	–	–
13	F	–	–	–	+		B	–	F	F	+	+
4	B	F	F	+	–	B		F	–	–	+	+
11	F	–	–	F	F	–	F		F	F	+	+
14	–	F	–	–	–	F	–	F		–	+	+
15	–	F	–	–	–	F	–	F	–		+	+
10	–	F	F	–	–	+	+	+	+	+		F
5	F	F	F	–	–	+	+	+	+	+	F	

Fig. 2. Self-cross pairings for Collybia confluens 7219, North Carolina.

pairings showed an ill-defined flat contact zone morphology, but most of these pairings were compatible. Flat and barrage contact zone morphologies could not be patterned, so subordinate mating types were assigned arbitrarily.

Intercollection mating: SBIs 7219:4, 5, 6 and 8 (North Carolina) were paired with SBIs 7262:1 and 2 (Sweden; only two SBIs established). All pairings were compatible.

Culture characteristics: Colonies were off-white and produced no discernible odor. Most of the mycelium was submerged; surface hyphae were often diverticulate (Desjardin, 1990), with small, stiff side branches as though thorny or with complex rameales or stag-horn structure (Desjardin, 1990). Short lengths of aerial hyphae were incrusted. Common wisps of individual hyphae or ropes of 2-3 individuals radiated up to 4 mm from inoculum blocks, appearing as though combed, connecting the donor blocks and projecting in all directions.

Commentary: Basidiospores shed directly on agar germinate slowly (starting at one week for at least seven weeks) and very sparsely (perhaps 1/10,000). Harvesting SBIs requires patience and it is difficult to obtain enough for an ample self-cross. Moreover, because basidiospores often germinate in the heaviest area of the spore print, it is difficult to isolate a single germinating basidiospore without other ungerminated basidiospores which might later germinate.

This is the first report of tetrapolarity in Collybia confluens, a member of sect. Vestipedes (cf. Halling, 1983). Murphy and Miller (1993) reported that C. subnuda (Ellis ex Pk.) Gilliam, also in Sect. Vestipedes (cf. Halling, 1983) was bipolar, and Petersen (1995b) and Petersen and Gordon (1994) noted that this was the only bipolar species of Collybia theretofore reported. Petersen (1995; unpubl. data) indicated that some evidence of tetrapolarity was also known in C. subnuda. A third species in sect. Vestipedes, C. luxurians Peck, has been reported as tetrapolar (Murphy, 1995). These data on members of sect. Vestipedes further isolate the report by Murphy and Miller (1993), and raise questions concerning the relationship of bipolarity and tetrapolarity and/or Halling's (1983) sectional taxonomy within the genus. Murphy (1995) reported that C. biformis (Pk.) Singer, included by Halling in sect. Subfumosae but similar to taxa in sect. Vestipedes, also was tetrapolar.

Although based on too small a statisticl sampling, intercompatibility between SBIs of 7219 and 7262 indicates that C. confluens spans the Atlantic Ocean as a single biological species.

Gloiodon strigosum (Swartz per Fr.) P. Karsten

Specimens used: SWEDEN, Uppland, vic. Uppsala, Fyby Urknog, 8.IX.94, coll. RHP, standing Populus sp., no. 7290 (TENN no. 53571); FINLAND, Etelä-Häme Prov., Lammi, Evo, Kotinen Virgin Forest, 13.IX.94, coll. R. Pentillä, on standing Populus sp., no. 7474 (TENN no. 53582).

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 3). Isolate 4* = A_1B_1; 3*, 7, 8, 11 = A_2B_2; 14* = A_1B_2; 9*, 12, 15 = A_2B_1; 1, 2, 10 were dikaryons.

Little morphological difference could be detected among various pairings, including flat and barrage reactions. Subordinate mating types, therefore, were assigned arbitrarily.

Intercollection mating: SBIs 7290:3, 4, 9 and 14 (Sweden) were paired with SBIs 7474:1, 5, 12 and 13 (Finland). All pairings exhibited abundant clamp connections and were interpreted as compatible.

Culture characteristics: Petersen (1976) described cultural characters of *Gloiodon strigosum* in detail. Colonies gave off the spicy-peppery odor typical of cultures of *Clavicorona*, *Auriscalpium*, and *Lentinellus*.

	A_2B_2				A_1B_1	A_2B_1			A_1B_2
	7	8	3	11	4	12	9	15	14
7		-	-	-	+	-	-	-	-
8	-		-	-	+	-	-	F	-
3	-	-		-	+	-	-	-	-
11	-	-	-		+	-	-	-	-
4	+	+	+	+		-	-	-	-
12	-	-	-	-	-		-	-	+
9	-	-	-	-	-	-		-	+
15	-	F	-	-	-	-	-		+
14	-	-	-	-	-	+	+	+	

Fig. 3. Self-cross pairings for *Gloiodon strigosum* 7474, Finland.

Gloeoplerous hyphae, common on the agar surface, were yellowish, slender (2-5 um broad), with multiguttulate to foamy contents. Although they often projected up to three mm from the agar surface, gloeoplerous hyphae fall over of their own weight.

Commentary: Basidiospore germination in Gloiodon is very low - perhaps 1/1000. Moreover, germinating basidiospores often are found in the thickest part of the spore print on agar, and even though excess spores may be wiped away manually, two germinating spores may be harvested (or one germinated basidiospore plus one about to germinate). This idiosyncracy could account for the relatively high frequency of dikaryons in the sample.

Gloiodon strigosum is tetrapolar, as are other species and genera placed in the Auriscalpiaceae (Maas Geesteranus, 1963, 1978; (Wu and Petersen, 1992; Petersen and Wu, 1991; Wu et al., 1995; Petersen and Cifuentes, 1994; Wu, 1991; Petersen, 1995b). If Hericium is included in this family, it extends tetrapolarity (Ginns, 1984, 1985) even further. With these reports, the family is actually one of the better undersood for mating systems. In addition to sulfobenzaldehyde-positive gloeoplerous hyphae and gloeocystidia (a reaction which defines the term gloeocystidium), and basidiospores with amyloid ornamentation, the group seems unified by the deposition of unique compounds thought to be insect-repellant (steroylvelutinal, vellereol), also found in basidiomata of Lactarius, Russula, Bondarzewia, Heterobasidion and Vararia (Gluchoff-Fiasson and Kühner, 1982; Steglich and Sterner, 1988; Sterner et al., 1985).

Intercompatibility between SBIs from Sweden and Finland indicates that a single biological species is distributed throughout Scandinavia. Whether North American collections also belong to this biological species is still unknown.

Hypsizygus tessulatus (Bull.: Fr.) Singer

Specimen used: UNITED STATES, Alaska, Anchorage, Pop Carr Park, 61° 10.693' N, 149° 53.963' W, 17.IX.95, coll. RHP, on Populus, no. 8207 (TENN 53876).

Mating system: When 9 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 4). Isolates 7*, 11 = A_1B_1; 1*, 2, 3 = A_2B_2; 8* = A_1B_2; and 4*, 5, 10 = A_2B_1. Coomon-A and common-B reactions ranged from ill-defined to well-defined. Subordinate mating types were assigned based on the following: 1) well-defined contact zone morphologies were analysed separately as follows: a) 8 X 7 and 1 X 8 distinctly flat (more or less well-defined crevasse); and b) 5 X 7 and 3 X 8 distinctly barrage (congested aerial mycelium along the mid-line). If 8 X 7 is taken as definitive, then all these isolates share an A gene. If 3 X 8 and 5 X 7 are read as more distinctly barrage, then the latter isolates share a B gene. Subordinate mating types were assigned using the latter paradigm.

	A_2B_2			A_2B_1			A_1B_2	A_1B_1	
	1	2	3	4	5	10	8	11	7
1		–	–	F	–	–	F	+	+
2	–		F	–	–	–	F	+	+
3	–	F		–	F	F	B	+	+
4	F	–	–		–	F	+	–	F
5	–	–	F	–		–	+	–	B
10	–	–	F	F	–		+	–	F
8	F	F	B	+	+	+		F	F
11	+	+	+	–	–	–	F		F
7	+	+	+	F	B	F	F	F	

Fig. 4. Self-cross pairings for Hypsizygus tessulatus 8207, Alaska.

Culture characteristics: Basiiospore germination in this species is very sparse, and even in relatively heavy spore prints on agar it is uncommon to harvest enough germlings for a valid self-cross. In the case of 8207, only 12 SBIs were harvested, and two of these were physiologically aberrant. A previous collection from far eastern Russia, all SBIs of which were clamped, was assumed to be amphithallic.

Aerial hyphae were lightly incrusted with needle-like crystals, while hyphae closer to the agar surface were either not so, or occasionally covered with scattered blisters of liquid. Cultures from another collection [RUSSIA, terr. Primorsk, dist. Ternei, Sichote Alin Biosphere Reserve, 24.IX.90, coll. RHP, at base of Quercus, no. 3364 (TENN 49464)] produced broadly clavate chlamydospores (Fig. 5b) bacilliform arthroconidia (Fig. 5c), and hyphae covered with resinous blisters (Fig. 5a). When nematodes were exposed to mycelium of this culture, they became moribund within five minutes and dead within two hours (Petersen, 1993).

Lentinellus castoreus (Fr.) Konr. & Maubl.

Specimen used: SWEDEN, Uppland, vic. Uppsala, Gottsunda-bogen, 7.IX.94, coll. V. Emmett, on Populus log, no. 7267 (TENN no. 53539).

Mating system: When 11 single-basidiospore isolates were paired in all combinations, a bifactorial mating system was revealed (Fig. 6). Isolate 4* = A_1B_1; 1*, 3, 9, 11, 12 = A_2B_2; 10* = A_1B_2; 2*, 7, 13, 14 = A_2B_1. Although occasional "flat" reactions (putative common-A matings) were noted, these were often ill-defined, and did not transect the entire contact zone. Instead, lethal reactions were noted and equated with common-A pairings. When such lethal reactions and "flat" morphologies were coupled, they seemed to appear in one quadrant of the adjusted self-cross grid more frequently than in other quadrants. Subordinate mating types, therefore, were assigned based on these combined lethal/flat reactions. "Barrage" reactions (putatively common-B matings) were not distinguishable.

Donor mycelium made contact reluctantly, was often submerged, and often passed in different planes. Hyphae at the agar surface were the last to meet and mingle, and appeared to be predominately gloeoplerous in content.

Culture characteristics: From the inoculum block of both monokaryon and dikaryon cultures, a number of submerged "tendril" systems radiated outward, usually 12-18 in number. Each consisted of a loose core of many stout radial hyphae with complex systems of secondary and tertiary side-branches. The resultant colony resembled an ill-defined octopus. In most cases, the agar slowly turned mauve,

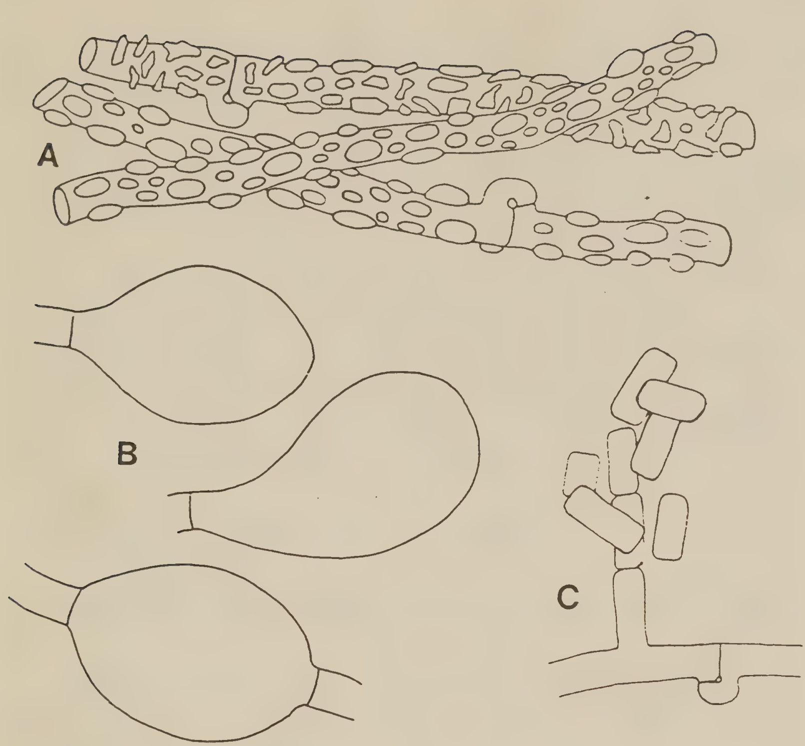

Fig. 5. Micromorphology of cultures of *Hypsizygus tessulatus* 3364, Russia. a. Vegetative hyphae with nematoxic liquid blisters. b. Broadly clavate, thin-walled chlamydospores. c. Bacilliform arthroconidia.

especially around inoculum blocks, and the inoculum blocks themselves turned fuscous fleshy brown. All colonies produced a very faint odor (spicy-peppery) typical of the family.

Hyphae of all cultures tended to be torulose to strangulate in outline, often appearing almost empty and then with one or a few oil droplets. Hyphal tips were often inflated into thin-walled, ellipsoid allocysts. Chlamydospores were present as thick-walled, spherical to subspherical, terminal or intercalary cells with shining contents. These were most conspicuous when the surrounding cells were evacuated.

Gloeoplerous hyphae were dull yellow and generally of the same width as generative hyphae in cultures.

	A_2B_2					A_1B_1	A_1B_2	A_2B_1			
	1	9	3	11	12	4	10	13	14	2	7
1		L	-	-	-	+	L	-	-	-	L
9	L		-	-	-	+		F	-	L	-
3	-	-		-	L	+	-	F	L	-	-
11	-	-	-		-	+	-	-	-	L	-
12	-	-	L	-		+	L	-	L	L	L
4	+	+	+	+	+		-	L	-	-	-
10	L		-	-	L	-		+	+	+	+
13	-	F	F	-	-	L	+		-	F	-
14	-	-	L	-	L	-	+	-		-	-
2	-	L	-	L	L	-	+	F	-		L
7	L	-	-	-	L	-	+	-	-	L	

Fig. 6. Self-cross pairings for Lentinellus castoreus 7267, Sweden.

Gloeoplerous hyphal tips were often somewhat differentiated: clavate to fusiform-curved, septate into 3-6 slightly inflated cells, repeatedly sinuate, etc. Gloeoplerous hyphae bore common clamp connections, more easily observed than those on generative hyphae.

Although clamp connections were common to abundant, they were not abrupt or papillate in outline, but resembled peg-like side branches. Clamps were observed only hyphae at the agar-surface or very slightly submerged, but not on deeply submerged hyphae, even though the latter were the first to mingle in contact zones.

In a few cases, clavarioid primordia formed on inoculum blocks. In no case was the pairing compatible, however, and the primordia were without spores.

Identification: Field identification was made by Svengunnar Ryman (pers. comm.), supplemented with Moser's (1983) key. Basidiomata are recognizable by the deeply rivulose pileus surface, as opposed to the pruinose or hirsute pileus surface (at least near the stipe attachment) of _L. vulpinus_ (Fr.) Kühner & Maire and _L. ursinus_ (Fr.) Kühner. Basidiomata of _L. castoreus_ are pleurotoid (i.e. laterally or sublaterally stipitate), while those of _L. omphaloides_ (Fr.) Karsten are centrally to eccentrically stipitate, and those of _L. cochleatus_ (Pers.: Fr.) Karst. are laterally stipitate but usually imbricate. Basidiomata of most _Lentinellus_ species are acrid in taste, and those of TENN 53539 were slowly but strongly so.

Marasmiellus candidus (Bolt.: Fr.) Singer

Specimen used: UNITED STATES, Washington, Jefferson Co., Olympic National Park, Hoh River Visitors Center, 13.X.92, coll. RHP, on dead stems of shrub, no. 5838 (TENN 54508; used for self-cross).

Mating system: When 11 SBIs isolates were paired in all combinations, a tetrapolar mating system was revealed (Fig. 7). Isolates 1*, 6, (10) = A_1B_1; 7*, 9, 11, 14, 15 = A_{2B2}; 2* = A_2B_1; 3*, 5 = A_1B_2.

Putative "barrage" and "flat" contact zone morphologies could not be patterned (see 3/5 X 15, and 3/5 X 6, both putative "barrage"), so subordinate mating types (i.e. A_1B_2, A_2B_1) were assigned arbitrarily.

SBI 10 produced ill-defined "barrage" reactions with SBIs 7, 11, 14, and 15 together with scattered clamp connections. With similar limited compatibility in 1 X 9 and 6 X 15, isolate 10 was probably A_1B_1. Culture characteristics: 1) mycelium of SBIs and contact zone slowly became encrusted with crystalline material; 2) within the contact zone, diverticulate hyphal complexes were formed, first on single hyphae, then expanding through contribution by several hyphae, and finally coalescing; and 3) odor of all isolates was at times penetratingly unpleasant.

Identification: All collections were identified by Dr. Dennis Desjardin.

Intercollection matings: As reported by Desjardin et al. (1993), tester strains of 5838 (Washington) were mated against tester strains of DED 4950 (Ohio) and 4960 (North Carolina). Partial intercompatibility was observed. Where clamp connections were observed in these pairings, they were almost always very sparse and often on aerial hyphae. In one case clamps were localized at the agar surface, a phenomenon termed "localized compatibility syndrome" by Petersen and Ridley (1996) in Pleurotus and observed in pairings in several other genera. With this in mind, false-incompatible readings are a distinct possibility. Although clamp connection formation (and perhaps dikaryotization) was episodic in these small-sample long-distance matings,

	A_2B_1	A_1B_2		A_1B_1		A_2 B_2					$?A_1B_1$
	2	3	5	1	6	7	9	14	11	15	10
2		+	+	–	–	–	–	–	–	–	–
3	+		– F	–	– B	–	–	–	–	– B	–
5	+	– F		–	– B	–	–	–	–	– B	– B
1	–	–	–		–	+	+	+	+	+	–
6	–	– B	– B	–		+	+	+	+	+	–
7	–	–	–	+	+		–	–	– B	– B	+ B
9	–	–	–	+	+	–		– B	–	–	–
14	–	–	–	+	+	–	– B		–	–	+ B
11	–	–	–	+	+	– B	–	–		–	+ B
15	–	– B	– B	+	+	– B	–	–	–		– B
10	–	–	– B	–	–	+ B	–	+ B	+ B	–	

Fig. 7. Self-cross pairings for Marasmiellus candidus 5838, Washington.

western North American strains recognize eastern North American strains, indicating that a single intersterility group spans the continent.

Commentary: Desjardin et al. (1993) reported tetrapolar mating systems for M. opacus (B&C) Singer and M. tenerrimus var. setulosus (Joss. & Smith) Desj.. Marasmiellus candidus was reported as tetrapolar in the abstract to that paper, but textual material was removed before publication. Thus, including data from this paper, Marasmiellus would appear uniformly tetrapolar. The genus, however, is quite large, and sampling for mating systems is still embryonic. Data from Marasmius (Petersen, 1995b), Collybia (Petersen, 1995b; this paper), Agrocybe (Rehner, 1989), Melanotus (Petersen, 1992b, c) and other genera indicate the presence of bipolarity and tetrapolarity within single generic units.

Marasmiellus ramealis (Bull.: Fr.) Singer

Specimen used: SWEDEN, Uppland, vic. Uppsala, 3.IX.94, collector unknown, on hardwood leaves, no. 7248 (TENN no. 52628).

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 8). Isolates 1, 5, 9, 16* = A_1B_1; 6*, 15 = A_2B_2; 2, 13*, 17 = A_2B_1; 7, 11, 14* = A_1B_2.

If only presence/absence of clamps is interpreted, the grid is clearly bipolar, but when barrage and flat morphologies are patterned, the tetrapolar grid becomes obvious. Subordinate mating types were assigned based on patterns of barrage and flat reactions.

Two types of flat morphology were noted: 1) ill-defined, always incompatible; and 2) clearly defined, with bordering congested hyphae, usually with localized or widespread clamps. The former morphology was patterned (i.e. 7/11/14 X 1/5/9/16 = common-A) and was accepted as a true flat reaction. Barrage morphology was never well-defined: an indefinite transecting area of somewhat congested hyphae, usually with localized or widespread clamps, but patterned (i.e. 2/3/17 X 1/5/9/16 = common-B).

Culture characteristics: Colonies were off-white, with generally submerged or sparse agar-surface hyphae and a fainly floral odor. When the mycelium reached the Petri dish margin, it grew upward on the plastic and usually produced amorphous orange-brown areas. No such color was seen on the agar surface. Agar-surface hyphae were usually diverticulate, with the diverticulae often occurring in fascicles. Very limited lengths of these hyphae were heavily incrusted with crystalline material. Aerial hyphae were rarely diverticulate, and when branched, were of the stag-horn type (Desjardin, 1989). Aerial hyphae often exhibited narrowly ampulliform septa (both with or without clamps).

	A_1B_1				A_1B_2			A_2B_1			A_2B_2	
	5	16	1	9	11	14	7	2	13	17	15	6
5		−F	B	−F	−F	−F	−	B	+B	+F	+	+
16	−F		−	−	−F	−	−	B	+B	+B	+	+
1	B	−		−	−	−F	−	+F	B	+F	+	+
9	−F	−	−		−F	−F	−F	+B	+B	+F	+	+
11	−F	−F	−	−F		−	−F	+	+	+	+F	+F
14	−F	−	−F	−F	−		−	+	+	+		+F
7	−	−	−	−F	−F	−		+	+	+	+B	+F
2	B	B	+F	+B	+	+	+		−F	−F	−	−F
13	+B	+B	B	+B	+	+	+	−F		−	−	−
17	+F	B	+F	+F	+	+	+	−F	−		−	−
15	+	+	+	+	+F	−	+B	−	−	−		−
6	+	+	+	+	+F	+F	+F	−F	−	−	−	

Fig. 8. Self-cross pairings for *Marasmiellus rameal*is 7248, Sweden.

Commentary: Occurrence of mating systems in which common-A and common-B often produce localized clamp connections or false clamps are uncommon. Other reported species of *Marasmiellus*, although few, do not share this characteristic, although the same two flat morphologies were noted in *M. stenophyllus* (see below).

Literature on mating systems in Marasmiellus is limited to the report by Desjardin et al. (1993) on M. tenerrimus var. setulosus, M. opacus, and M. candidus.

Marasmiellus stenophyllus (Mont.) Singer

Specimen used: UNITED STATES, Georgia, Rabun Co., Warwoman Game Refuge, Overflow Creek Road, 18.VII.94, coll. RHP, on hardwood leaves, no. 7211 (TENN 53524).

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 9). Isolate 6* = A_1B_1; 15* = A_2B_2; 13* = A_1B_2; 1*, 3, 4, 5,

	A_2B_1									A_1B_2	A_2B_2	A_1B_1
	3	4	5	1	7	9	10	11	12	13	15	6
3		–	– F	– F	–	–	–	–	–	+	F	–
4	–		–	–	+ B	–	–	–	–	+ B	F	B
5	– F	–		–	+ B	–	–	–	– F	+	– F	– B
1	– F	–	–		–	–	–	–	–	+	–	–
7	–	+ B	+ B	–		+ B	B	B	+ B	+	–	+ B
9	–	–	–	–	+ B		+ B	F	– F	+	F	B
10	–	–	–	–	B	+ B		–	–	+	F	–
11	–	–	–	–	B	F	–		–	+	F	–
12	–	–	– F	–	+ B	– F	–	–		+	F	–
13	+	+ B	+	+	+	+	+	+	+		–	–
15	F	F	–	–	–	F	F	F	F	–		+
6	–	B	– B	–	+ B	B	–	–	–	–	+	

Fig. 9. Self-cross pairings for Marasmiellus stenophyllus 7211, Georgia.

7, 9, 10, 11, 12 = A_2B_1. Subordinate mating types were assigned based on flat reactions (common-A mating) between 15 X 1/3/4/5/7/9/10/11/12.

The following hyphal differentiation was observed within the contact zone: 1) transecting band of congested, branched hyphae, either submerged or aerial, but often asymmetrical. Although noted as "barrage," this differentiation was unpatterned and apparently artifactual; 2) either ill-defined crevasse (small F on self-cross grid) or well-defined crevasse bounded by "lips" of congested, branched hyphae, and usually with lethal reactions within the contact zone. The latter was accepted as a true "flat" reaction (large F on self-cross grid). This phenomenon was patterned and was used as stated above.

Culture characteristics: Bisymmetrical, square/double-triangular crystals appeared in the agar. When aerial mycelium was formed, short hyphal lengths were commonly incrusted with such crystals. Hyphae were relatively constant in width (1.5-4 um diam) and radial in incompatible pairings. Clamps were consistently small and inconspicuous. Isolates 7 and 9 seemed prone to form scattered, sparse clamps, but this habit was not patterned.

Two types of branches were formed on agar-surface hyphae: 1) "picket fence" with a row of small, simple knobs or side branches; and 2) single or fasciculate (in very small numbers) erect, coralloid to arborescent side branches (perhaps a weak rameales structure). Identification: An unpublished key to southern Appalachian Marasmiellus taxa devised by Dr. D.E. Desjardin was used for initial identification. Using this name, the specimen was compared to the description by Desjardin (1987) and Breitenbach and Kränzlin (1991).

Marasmius epiphyllus (Pers.: Fr.) Fries

Specimen used: UNITED STATES, Alaska, vic. Anchorage, Eagle River Valley Visitors' Center, 12.IX.95, coll. K.W. Hughes & RHP, on dead leaves of Populus, no. 8127 (TENN 53916).

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 10). Isolates 1*, 8 = A_1B_1; 5*, 7, 9, 10 = A_2B_2; 2*, 13 = A_1B_2; 3*, 4, 14 = A_2B_1. Isolate 12 was dikaryon, in spite of initial examination for presence/absence of clamp connections. Virtually no evidence of barrage or flat reactions was observed. All pairings appeared to overgrow with no differentiation or interference.

	A_1B_1		A_2B_1			A_2B_2				A_1B_2		
	1	8	3	4	14	7	10	9	5	2	13	12
1		−	−	−	−	+	+	+	+	−	−	+
8	−		−	−	−	+	+	+	+	−	−	+
3	−	−		−	−	−	−	−	−	+	+	+
4	−	−	−		−	−	−	−	−	+	+	+
14	−	−	−	−		−	−	−	−	+	+	+
7	+	+	−	−	−		−	−	−	−	−	+
10	+	+	−	−	−	−	−	−	−	−	−	+
9	+	+	−	−	−	−	−		−	−	−	+
5	+	+	−	−	−	−	−	−		−	−	+
2	−	−	+	+	+	−	−	−	−		−	+
13	−	−	+	+	+	−	−	−	−	−		+
12	+	+	+	+	+	+	+	+	+	+	+	

Fig. 10. Self-cross pairings for *Marasmius epiphyllus* 8127, Alaska.

Culture characteristics: Colony color was nearly translucent/white to very pallid dull apricot color and in all cases, appeared wet. Microscopically, all hyphae were involved in slime, from individual aerial hyphae with a slime sheath and slime droplets to agar-surface hyphae often within a slimy matrix. Individual hyphae were broad (6-9 um diam), yellowish, with multigranular to multiguttulate contents, as though gloeoplerous or laticiferous and commonly septate. Clamp connections were were not observed on a majority of septa. Frequently the hyphae were torulose and sometimes inflated into rows of subspherical cells. Such cells often contained a central mass of gloeoplerous material but were thin-walled and, as merely the most pronounced of the hyphal swellings, could not be termed chlamydospores. Colonies produced no discernable odor.

Commentary: Terra (1953) included M. epiphyllus in a list of taxa for which mating systems had been ascertained. Her European material was tetrapolar. In a key to European Marasmius taxa of sections Gloiocephala and Epiphylli, Noordeloos (1987) distinguished between two-spored and four-spored forms. Marasmius tremulae was included with the two-spored forms, while M. epiphyllus was considered to be four-spored. It is unlikely that the two-spored form would be overtly tetrapolar, for such forms are often amphithallic and mask their true genetic mating system (see Petersen, 1995a). The Alaskan specimen reported above, as well as additional collections from Alaska, was four-spored. Intercontinental compatibility within this species from Alaska and Scandinavia has been reported by Petersen and McCleneghan (1996).

Marasmius minutus Peck

Specimen used: UNITED STATES, Georgia, Rabun Co., War Woman Game Refuge, near river campground, 18.VII.94, coll. RHP & S. Spellmeyer, on blackened, dead stem tips and associated leaves of Leucothoë, no. 7212 (TENN 53727).

Mating system: Unknown. When 12 single-spore isolates were paired in all combinations, no contact zone differentiation could be observed, no clamp connections were observed, and no binucleate cells were detected under epifluorescence microscopy (using DAPI).

Culture characteristics: Polyspore cultures and 20 SBIs were established. All bore the following characteristics: 1) hyphae mostly appressed, very pallid yellow or off-white, 1.5-4.5 um diam, often in ropes of 5-20, involved in slime sheaths which extended some distance from individual hyphae, occasionally with short, slender ramifying branchlets, but otherwise undifferentiated; 2) broader hyphae on or near the agar surface appear to gelatinize their walls (walls with interior surface well-defined, but exterior surface not so), while narrower agar-surface hyphae do not gelatinize. Agar consistency is very stiff and rubbery, far more so than normal. Clamp connections were extremely rare on vegetative hyphae in polyspore cultures.

Abundant (20-35 per 60-mm Petri plate) tan-brown, tan (or in one case, white), small (less than 1 mm diam), dry (without slime) hyphal balls were formed, scattered over the agar surface. These exhibited the following characteristics:

1) surface covered with fascicles of slender (2-3.5 um diam), thick-walled (at least proximally; 0.5-0.7 um thick) hyphae; 2) fascicles extending up to 150 um from surface; fascicle hyphae with common, obvious clamp connections; 3) interior hyphae 1-1.5 um diam, hyaline singly, but tan-brown in mass, thick-walled (up to 0.5 um thick), densely congested to form a tissue (but more or less interwoven rather than pseudoparenchymatous); and 4) when crushed, these hyphal balls liberated copious amorphous hyaline sludge.

Commentary: I interpret the small hyphal balls as soft sclerotia, with internal hyphae aggregated as sclerotial tissue and with exterior of hyphal fascicles. In fact, some basidiomata bore such structures at the base of the stipe. The viscous interior of sclerotia and slime context around vegetative hyphae may all act as water conservation features. If these vegetative characteristics correlate with an abbreviated sexual cycle (amphithallism or asexual reproduction), the total might be of advantage to an adventitious organism invading a weakened host under significantly fluctuating moisture conditions.

Identification: Keys and descriptions by Desjardin (1989).

Mycena aurantiomarginata (Fries) Quèlet

Specimen used: UNITED STATES, Alaska, vic. Anchorage, Arctic Valley Road, 61° 14.112′ N, 149° 37.047′ W, 11.IX.95, coll. RHP, on Alnus leafmold, no. 8113 (TENN 53915).

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 11). Isolates 4*, 12, 13 = A_1B_1; 1*, 5, 10 = A_2B_2; 6*, 8 = A_2B_1; 2, 3*, 14, 15 = A_1B_2.

Although ill-defined flat and barrage contact zone morphologies were noted, as well as lethal reactions, none could be patterned, and subordinate mating types were assigned arbitrarily.

Culture characteristics: Colonies white, usually with a central patch of congested aerial hyphae, abruptly becoming appressed to submerged outward, and occasionally obscurely zonate. Deposits of minute amorphous crystals were common in the contact zones, especially when accompanied by lethal reactions. Colonies exhibited no discernable odor.

	A_2B_2			A_1B_1			A_2B_1		A_1B_2			
	1	5	10	4	12	13	8	6	2	3	14	15
1		B	−	+	+	+	−	−	−	B	−	−
5	B		−	+	+	+	F	B	F	B	−	−
10	−	−		+	+	+	−	−	−	B	−	−
4	+	+	+		F	−	−	F	F	B	−	−
12	+	+	+	F		F	B	−	−	−	−	−
13	+	+	+	−	F		F	F	−	F	−	F
8	−	F	−	−	B	F		F	+	+	+	+
6	−	B	−	F	−	F	F		+	+	+	+
2	−	F	−	F	−	−	+	+		B	−	−
3	B	B	B	B	−	F	+	+	B		−	−
14	−	−	−	−	−	−	+	+	−	−		−
15	−	−	−	−	−	F	+	+	−	−	−	

Fig. 11. Self-cross pairings for *Mycena aurantiomarginata* 8113, Alaska.

Mycena rosella (Fr.) Quelet

Specimen used: FINLAND, Prov. Etelä-Häme, Lammi, Biological Station forest, 14.IX.94, coll. RHP, on leaf mold of *Pinus*, *Picea*, *Populus*, and *Corylus*, no. 7484 (TENN 53614).

Mating system: When 12 single-basidiospore isolates were paired in all combinations, a tetrapolar mating system was revealed (Fig. 12). Isolates 4*, 13 = A_1B_1; isolates 5*,6 ,12, 14, 17 = A_2B_2; isolates 1*, 8, 10, 16, 18 = A_1B_2; A_2B_1 was unrepresented in the sample.

All isolates (mono- and dikaryon) grew slowly and very compactly. Immediately behind the growing margin, agar-surface hyphae developed "picket fence" branching, then complicated, dichotomously branched rameales structure.

After making contact in pairings, this rameales structure could be differentiated as follows: 1) ceasing to form behind the growing margins, creating a zone with no aerial hyphae, in which only agar-surface and submerged hyphae were present - invariably incompatible; 2) copious rameales structure, but with only sparse aerial hyphae - invariably incompatible; or 3) abundant aerial hyphae which, in most such pairings, also produced rameales structure or dense diverticulate branching - invariably compatible. Clamp connections were usually large, but only occasional, and then rendered obscure by the abundance of diverticulate branches and pegs. In some cases, a very weak transecting line of increased hyphal production was seen, and when examined, proved to be dikaryotic. Because common-A and common-B reactions were not discernable or patterned, subordinate mating types were assigned arbitrarily.

The widest variation in mating reactions occurred "within-group." In the grid, "X" marks certain pairings which were so repulsive that the two isolates never approached each other.

Culture characteristics: Colonies were minutely granulose as a result of rameales structure production, and very tardily turned pallid lemon yellow starting with the inoculum block. No discernable odor was noted.

Commentary: This species would appear to be well-defined in the North Temperate flora. Maas Geesteranus (1992a, b) and Smith (1947) reported a habitat restriction to coniferous needles, and the specimen cited above was on mixed forest litter including _Pinus_. Photographs were provided by Emmett (1992) and Smith (1947), and microscopic structures were illustrated by Maas Geesteranus (1992b). Smith (1947) placed the species in Sect. _Calodontes_ subsect. _Granulatae_, but Maas Geesteranus (1992b) included it in sect. _Luculentae_ subsect. _Rosellae_.

Intercontinental compatibility in _M._ _rosella_ between Alaska and Finland has been reported by Petersen and McCleneghan (1996).

Omphalotus illudens (Schwein.) Singer

Specimen used: UNITED STATES, Tennessee, Scott Co., Big South Fork National Recreation Area, 22.X.95, coll. S.C. McCleneghan, in _Quercus_-_Fagus_ forest, no. 6951 (TENN 54507).

Mating system: When 11 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 13). Isolates 2*, 9, 13 = A_1B_1; 3*, 10, 12, 14 = A_2B_2; 6*, 15, (4) = A_2B_1; 11 = A_2B_2 + A_1B_2. Assignment of subordinate

	A_1B_1		A_2B_2					A_1B_2				
	13	4	5	6	12	14	17	8	18	10	16	1
13		–	+	+	+	+	+	F	–	–	–	–
4	–		+	+	+	+	+	–	F	F	F	–
5	+	+		X	–	–	–	–	F	F	F	–
6	+	+	X		–	–	–	–	–	–	–	F
12	+	+	–	–		–	–	–	F	–	F	–
14	+	+	–	–	–		–	–	–	–	–	–
17	+	+	–	–	–	–		–	–	–	–	–
8	F	–	–	–	–	–	–		X	–	–	B
18	–	F	F	–	F	–	–	X		+	–	+
10	–	F	F	–	–	–	–	–	+		F	–
16	–	F	F	–	F	–	–	–	–	F		X
1	–	–	–	F	–	–	–	B	+	–	X	

Fig. 12. Self-cross pairings for *Mycena rosella* 7484, Finland.

mating types was made based on 6/15 X 3/10/12/14 (common-A). Although behavior of isolate 4 remains unexplained, contact zone morphologies indicate its mating type.

Flat reactions were noted as ill-defined versus well-defined. Well-defined flats were commonly noted for within-group pairings (3/10/12/14 X 3/10/12/14). A mixture of flats and barrages (if truly barrages: increased branching in a transect through the contact zone) were seen in 11 X 4/6/15, generally confirming the identity of isolate 11's double mating types.

Microscopically, contact zones of compatible pairings were composed of fascicles of upright, stiff-appearing branches, usually disarticulating into arthrospores, and

	A_1B_1			A_2B_1			A_2B_2				*
	2	13	9	15	6	4	10	12	3	14	11
2		F	–	–	–	+	+	+	+	+	+
13	F		–	–	F	–	+	+	+	+	+
9	–	–		–	–	–	+	+	+	+	+
15	–	–	–		–	–	–	F	F	–	+
6	–	F	–	–		F	–	F	F	B	+
4	+	–	–	–	F		–	B	F	–	+
10	+	+	+	–	–	–		F	–	F	–
12	+	+	+	F	F	B	F		–	F	F
3	+	+	+	F	F	F	–	–		F	F
14	+	+	+	–	B	–	F	F	F		–
11	+	+	+	+	+	+	–	F	F	–	

* $A_2B_2 + A_1B_2$

Fig. 13. Self-cross pairings for Omphalotus illudens 6951, Tennessee.

always bearing blisters of resinous liquid as well as common clamp connections. Although clamps were most easily observed on submerged hyphae, compatible matings were sometimes accompanied by lethal reactions which obscured observation of submerged hyphae.

While the self-cross grid of 6951 is not ideal, it is more clearcut than those for other collections of the same species (Petersen, unpubl. data). In those grids, amphithallic behavior was more common, often with several possible explanations for mating types of individual strains, but never satisfying the normal patterns for tetrapolarity.

Commentary: Anomalies in self-cross grids may be caused by the mode of spore germination. Basidiospores germinate slowly and usually in the heaviest areas of a spore print. Timing of germling harvest is critical, for additional spores will germinate over a period of many days, causing dikaryons or hemicompatible combinations of two or more spores to be harvested together. It is necessary to carefully wipe away as many extraneous basidiospores as possible, but even when this is accomplished, occasional doublets may be harvested. Some can be screened out by examination for clamps, but others (hemicompatible) will survive examination.

Bardin (1959) noted that "diploid mycelium" obtained by germination of basidiospores of Clitocybe olearius were binucleate, and very frequently clamped (investigated more fully by Carey, 1974). Years later, Lamoure (1989) reported that O. olearius was tetrapolar with uninucleate basidiospores.

In describing the Omphalotaceae, Kämmerer et al. (1985) did not mention mating systems. In the family were placed Omphalotus and Lampteromyces, which roughly are analogous to Pleurotus ostreatus (Jacq.: Fr.) Kummer (without annulus) and P. dryinus (Pers.: Fr.) Kummer (with annulus). Basidiomata of all tested members of the Omphalotaceae are bioluminescent and at least some are toxic to humans. Based on secondary metbolite production, the family was considered closely related to the Paxillaceae of the Boletales.

Miller (1994) reported that O. nidiformis (Berk.) Miller from Australia (including a wide variation in pileus color, and three assumed taxonomic synonyms) was tetrapolar. Results from oher Omphalotus species reliably tested (Petersen, unpubl. data) may indicate that O. mexicanus Guzman is not amphithallic as previously concluded (Petersen, unpubl. data), but merely a victim of careless harvesting of SBIs. The latter species has not been reported for bioluminescence.

The wide variation of pileus color within a single intersterility group (= biological species) in O. nidiformis (Miller, 1994) may parallel reported intercompatibility among the European O. olearius (DC: Fr.) Sing. and the American O. illudens (Schwein.) Sing., O. subilludens (Murr.) Big. and O. olivascens Bigelow et al. (Miller, pers. com.; Petersen, 1977) which also differ significantly in color and spore statistics. This paradigm is also found in Pleurotus (Petersen, 1995a, b) and Lentinula (Mori et al., 1974; Shimomura et al., 1992; Petersen, 1995a), where a single intersterility group shelters wide morphological variation.

Omphalotus (and the Omphalotaceae) has been considered closely related to the Paxillaceae through unique secondary metabolites (Kämmerer et al., 1985), and, if true, reports of mating systems in Omphalotus may afford some insight into similar phenomena in the Paxillaceae, where basidiospores are difficult or impossible to germinate under normal laboratory conditions, and from which no such reports have been made.

Omphalotus olivascens Bigelow, Miller & Thiers

Specimen used: UNITED STATES, California, Marin Co., Mt. Tamalpias watershed, Mt. Tamalpias, 9.II.96, coll. J.R. Blain, det. D.E. Desjardin, on standing dead Pseudotsuga menziesii, DED 6450, CULTENN no. 8283 [spore print

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 14). Isolates 1, 11* = A_1B_1; 12* = A_2B_2; 5*, 9, 10 = A_1B_2; 2, 3*, 6, 7, 14, 17 = A_2B_1. Subordinate mating types were assigned based on 1/11 X 5/9/10 = common-B (barrage).

While all incompatible pairings took on tan to ochre coloration, usually typically ochraceous tan, donor colonies of all compatible pairings remained essentially white, and compatible pairings could be predicted with the naked eye by this characteristic. In one case, a compatible mating donor took on some color, but it was on the obverse side of the inoculum block. The possible mechanism of mating compatibility controlling colony color remains unknown.

Culture characteristics: As noted by Bigelow et al. (1976), colonies take on ochraceous to tan coloration as they mature, although the hyphae remain hyaline throughout maturity of the colony. Colony coloration is caused by hyaline guttation droplets which turn to amber color and expand during colony development, giving the colony its characteristic color. While all pairings deposited some straw or amber coloration into the agar, hyphae were healthy and no physiological inhibition had occurred up to the time of reading.

	$A_2 B_1$						$A_1 B_2$			A_2B_2	A_1B_1	
	17	2	3	14	6	7	9	10	5	12	11	1
17		-	-	-	F	-	+	+	+	-	-	-
2	-		-	-	-	-	+	+	+	B	-	-
3	-	-		-	-	-	+	+	+	-	-	-
14	-	-	-		-	-	+	+	+	B	-	-
6	F	-	-	-		-	+	+	+	-	-	-
7	-	-	-	-	-		+	+	+	-	-	-
9	+	+	+	+	+	+		-	-	-	B	-
10	+	+	+	+	+	+	-		-	-	B	-
5	+	+	+	+	+	+	-	-		-	B	B
12	-	B	-	B	-	-	-	-	-		+	+
11	-	-	-	-	-	-	B	B	B	+		-
1	-	-	-	-	-	-	-	-	B	+	-	

Fig. 14. Self-cross pairings for *Omphalotus olivascens* DED 6450, California.

Commentary: Color and texture of colonies most closely match those of southern European cultures of *O. olearius*. Cultures of *O. illudens* and *O. nidiformis* remain almost white throughout maturity, as noted by Bigelow et al. (1976).

More discussion of this genus may be found under *O. illudens* above.

Phyllotopsis nidulans (Pers.: Fr.) Singer

Specimen used: COSTA RICA, Prov. San José, San Gerardo de Dota, Albergue de Montana, Savegre, 9° 33′ 2" N, 83° 48′ 27" W, elev. 2350 m, 21.VI.95, coll. RHP, on hardwood (?*Quercus*), no. 7878 (TENN 53739).

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 15). Isolate 6* = A_1B_1; 1*, 3 (14) = A_2B_2; 12* = A_2B_1; 2*, 4, (5), 7, 8, 10 (13) = A_1B_2. Mating types for isolates 5, 13 and 14 were assigned based on contact zone morphology and compatible 6 X 14 pairing. Subordinate mating types were

	A_2B_2			A_1B_1	A_1B_2							A_2B_1
	1	3	14	6	7	8	4	10	2	13	5	12
1		-	-	+	-	-	F	L	-	-	-	L
3	-		-	+	-	-	-	-	-	-	L	L
14	-	-		+	-	-	-	-	F	-	+	B
6	+	+	+		-	-	L	-	-	F	L	L
7	-	-	-	-		-	F	F	F	F	F	+
8	-	-	-	-	-		F	F	F	F	F	+
4	F	-	-	L	F	F		L	-	-	B	+
10	L	-	-	-	F	F	L		-	-	-	+
2	-	-	F	-	F	F	-	-		-	-	+
13	-	-	-	F	F	F	-	-	-		-	-
5	-	L	+	L	F	F	B	-	-	-		-
12	L	L	B	L	+	+	+	+	+	-	-	

Fig. 15. Self-cross pairings for *Phyllotopsis nidulans* 7878, Costa Rica.

assigned based on pairings 12 X 1/3/14 (common-A). Isolates 7 and 8 were consistent in contact zone morphology in pairings with 2, 4, 5, 10 and 13, although isolates 5 and 13 were incompatible with isolate 12. Causes of incompatible pairings (12 X 5/13) and few clamp connections in pairing 6 X 14 are unknown.

Culture characteristics: All colonies (monokaryon and dikaryon) were off-white, occasionally with very faint pinkish tints. Mycelium ranged from almost exclusively submerged to strongly aerial. When aerial mycelium was produced, it was delicately plumose, with branches more numerous toward the colony margin. Micromorphologically, two particular structures were noted: 1) uniform hyphal side branches with straight, tendril-like apices and sympodial branching pattern; and 2) coralloid hyphal branch tips on submerged hyphae. Clamp connections were large and conspicuous. No discernable odor was produced by cultures.

Commentary: Vandendries (1933) reported tetrapolarity for the species (as Pleurotus). Of 21 SBIs, the mating grid included at least five which unexplainably exhibited occasional incompatibility. In this way, Vandendries's results with this species were quite similar to those reported above.

Lamoure (1989) cited four reports (including Vandendries, 1933) of tetrapolar heterosexuality in P. nidulans. Of these, two (Lamoure, "résultats inédits;" Bastouill, 1977) were unavailable. Lamoure (1954) reported on spore germination and arthrospore production in this species but not mating system.

Intercompatibility among collections of P. nidulans from Alaska to Costa Rica has been reported by Petersen and McCleneghan (1996).

Steccherinum basi-badium Banker

Specimen used: COSTA RICA, Prov. San José, San Gerardo de Dota, Savegre, 9° 33.2' N, 83° 48.27' W, 2350 m, 21.VI.95, coll. RHP, on hardwood (?Quercus) log, no. 7884 (TENN 53829).

Basidioma micromorphology: Pileus profoundly dimitic. Generative hyphae 3-3.5 um diam, thin- to thick-walled (less than 0.5 um thick), hyaline, with clamp connections. Skeletal hyphae arising from generatives, 3.5-6.5 um diam, thick-walled (wall often obscuring the cell lumen), yellowish in mass, aseptate. Pileus surface a trichodermium composed of both hyphal types.

Spines with longitudinal skeletal hyphae, intertwined by generative hyphae. Generative hyphae 2.5-4 um diam, thin-walled, clamped, hyaline. Subhymenium extensive, of small, pseudoparenchymatous, clamped cells. Basidia 18-24 X 5.5-6.5 um, narrowly clavate, hyaline, clamped, tapering apically when young, 4-sterigmate.

Basidiospores 3-4 X 2-2.3 um, broadly ellipsoid, smooth, hyaline, thin-walled; hilar appendix extremely small.

	$A_1 B_1$			$A_1 B_2$			$A_2 B_1$			$A_2 B_2$		
	3	4	1	7	19	11	2	18	6	20	10	17
3		F	−	F	−	−	−	−	−	+	+	+
4	F		−	−	−	−	−	−	−	+	+	+
1	−	−		−	−	B	B	B	B	+	+	+
7	F	−	−		−	−	+	+	+	B	B	B
19	−	−	−	−		−	+	+	+	B	F	B
11	−	−	B	−	−		+	+	+	−	F	−
2	−	−	B	+	+	+		B	B	−	B	−
18	−	−	B	+	+	+	B		−	−	−	−
6	−	−	B	+	+	+	B	−		−	−	−
20	+	+	+	B	B	−	−	−	−		−	−
10	+	+	+	B	F	F	B	−	−	−		−
17	+	+	+	B	B	−	−	−	−	−	−	

Fig. 16. Self-cross pairings for Steccherinum basi-badium 7884, Costa Rica.

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 16). Isolates 1, 3*, 4 = A_1B_1; 10*, 17, 20 = A_2B_2; 7*, 11, 19 = A_1B_2; 2*, 6, 18 = A_2B_1.

Ill-defined flats were uncommon, could not be patterned, and significantly, no lethal reactions were observed. Barrages were also ill-defined, but seemed to group. The barrage of 7 X 20 was well-developed and subordinates were assigned using that pairing.

In compatible pairings, the dikaryon almost always bore telltale signs of a thin, white, loose tomentum which covered and followed the stout, "lead" hyphae from donor blocks. Thus, compatible pairings could be predicted with the naked eye. The dikaryon tomentum was composed of arboreal, sympodially branched, emergent hyphal complexes. Clamp connections were abundant on aerial hyphae and common to abundant on agar-surface hyphae.

In some dikaryons, hyphal tips were incrusted with hyaline crystals. This incrustation took two forms: 1) significant, evenly distributed deposits along the terminal 30-70 um; or 2) abrupt ball of crystalline deposit at the hyphal tip. Although some dikaryons were lightly incrusted, monokaryons were either unincrusted or lightly so.

Commentary: This specimen fits Maas Geesteranus's (1974) description. While very few encrusted cystidia were observed in basidiomata, nor any outward directed skeletal hyphae, dikaryon hyphae of cultures were usually incrusted.

The type specimen came from Mexico (No. 285 B.G., Murrill no. 253, Mexico, NY; examined by Maas Geesteranus): Costa Rica is not a remarkable range extension.

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BIBLIOGRAPHY

Bardin, R. 1959. Contribution a l'etude des myceliums de quelques Agaricales leucosporees de la famille des Tricholomataceae. Ann. Univ. [Lyon] C, 11: 31-38.

Bastouill, Y. 1977. Morphologie, cytologie et comportement nucléaire du mycélium de quelques Agaricales. Thesis, Univ. Lyon, ined.

Bigelow, H.E., O.K. Miller, and H.D. Thiers. 1976. A new species of *Omphalotus*. Mycotaxon 3: 363-372.

Breitenbach, J., and F. Kränzlin. 1991. "Fungi of Switzerland." Vol. 3. Edition Mykologia, Lucerne, Switzerland. 361 pp.

Carey, S.T. 1974. *Clitocybe illudens*: its cultivation, chemistry, and classification. Mycologia 66: 951-968.

Davis, J. 1996. Phylogenetics, molecular variation, and species concepts. BioScience 46: 502-511.

Desjardin, D.E. 1987. Tricholomataceae. I. Marasmioid genera: the genera *Baeospora*, *Crinipellis*, *Marasiellus*, *Marasmius*, *Micromphale*, and *Strobilurus*.. IN: "Agaricales of California," Ed. H.D. Thiers. Mad River Press, Eureka, CA. 99 pp.

Desjardin, D.E. 1989. The genus *Marasmius* from the southern Appalachian Mountains. Ph.D. dissertation, ined. Univ. Tennessee, Knoxville. 837 pp.

Desjardin, D.E. 1990. Culture morphology of *Marasmius* species. Sydowia 42: 17-87.

Desjardin, D.E., S.A. Gordon, and R.H. Petersen. 1993. Observations on two rhizomorph-forming species of *Marasmiellus*. Mycol. Res. 97: 111-122.

Emmett, E.E. 1992. British *Mycena* species - 2. Mycologist 6(3): 114-122 (pl. 1G).

Ginns, J. 1984. *Hericium coralloides* N. Amer. auct. (= *H. americanum sp. nov.*) and the European *H. alpestre* and *H. coralloides*. Mycotaxon 20: 39-43.

Ginns, J. 1985. *Hericium* in North America: cultural characteristics and mating behavior. Canad. J. Bot. 63: 1551-1563.

Gluchoff-Fiasson, K., and R. Kuhner. 1982. Le principe responsable du bleuissement au reactif sulfovanillique des cystides ou laticiferes de divers Homobasidiomycetes: interet taxonomique. C.R. Acad. Sci. Paris 294: 1067-1071.

Gordon, S.A., D.E. Desjardin, and R.H. Petersen. 1994. Mating systems in *Marasmius*: additional evidence to support sectional consistency. Mycol. Res. 98: 200-204.

Gordon, S.A., and R.H. Petersen. 1991. Mating systems in *Marasmius*. Mycotaxon 41: 371-386.

Gordon, S.A., and R.H. Petersen. 1992. Interbreeding populations of some *Marasmius* species. Mycologia 84: 204-208.

Halling, R.E. 1983. The genus *Collybia* (Agaricales) in the northeastern United States and adjacent Canada. Mycol. Mem. 8: 1-148.

Kämmerer, A., H. Besl, and A. Bresinsky. 1985. Omphalotaceae fam. nov., und Paxillaceae, ein chemotaxonomischer Vergleich zweier Pilzfamilien de Boletales. Plant. Syst. Evol. 150: 101-117.

Lamoure, D. 1954. Contribution à l'étude cytologique des germinations et du mycélium de quelques Agaricales, en particulier des Coprins de la section *Setulosi* (Lange). Ann. Univ. Lyon C, 8: 21-55.

Lamoure, D. 1989. Indices of useful information for intercompatibility tests in Basidiomycetes. V. - Agaricales *sensu lato*. Cryptogamie, Mycol. 10: 41-80.

Maas Geesteranus, R.A. 1963. Hyphal structures in hydnums. II. Proc. Koninkl. Nederl. Akad. Wissensch. C66: 426-457.

Maas Geesteranus, R.A. 1974. Studies in the genera *Irpex* and *Steccherinum*. Persoonia 7: 443-581.

Maas Geesteranus, R.A. 1978. Notes on hydnums. XI. Persoonia 9: 491-500.

Maas Geesteranus, R.A. 1992a. Mycenas of the Northern Hemisphere. I. Studies in Mycenas and other papers. Koninkl. Nederl. Akad. Wetensch. Verhandl., Tweede Reeks 90: 391 pp.

Maas Geesteranus, R.A. 1992b. Mycenas of the Northern Hemisphere. II. Conspectus of the Mycenas of the Northern Hemisphere. Koninkl. Nederl. Akad. Wetensch. Verhandl. Tweede Reeks 90: 493 pp.

Miller, O.K. 1994. Observations on the genus *Omphalotus* in Australia. Mycol. Helvetica 2: 91-100.

Morell, V. 1996. On the many origins of species. Science 273: 1496-1502.

Mori, K., Fukai, M., and A. Zennyozi. 1974. Hybridization of shii-ta-ke (*Lentinus edodes* between cultivated strains of Japan and wild strains grown in Taiwan and New Guinea. Mushroom Sci. 9: 391-403.

Moser, M. 1983. *Keys to agarics and boleti (Polyporales, Boletales, Agaricales, Russulales).* Roger Philipps, London, U.K. 535 pp.

Murphy, J.F. 1995. Microevolutionary studies in *Marasmiellus praeacutis* and *Collybia subnuda*, two litter-decomposing basidiomycetes. Ph.D. dissertation, ined., Virginia Polytechnic Institute and University, Blacksburg, VA. 90 pp.

Murphy, J.F., and O.K. Miller. 1993. The population biology of two litter decomposing agarics on a southern Appalachian mountain. Mycologia 85: 769-776.

Noordeloos, M. 1987.Notulae ad floram agaricinam Neerlandican - XV. *Marasmius*, *Marasmiellus*, *Micromphale*, and *Hohenbuehelia*. Persoonia 13: 237-262.

Petersen, R.H. 1976. Cultural characteristics of *Auriscalpium* and *Gloiodon*. Mycotaxon 3: 358-362.

Petersen, R.H. 1977. Species concepts in higher basidiomycetes: taxonomy, biology, and nomenclature. pp. 363-380, *IN* Clenecom, H., Ed. "The species concept in Hymenomycetes." J. Cramer, Vaduz.

Petersen, R.H. 1992a. Mating systems of three New Zealand agarics. New Zealand J. Bot. 30: 189-197.

Petersen, R.H. 1992b. *Melanotus eccentricus*: cultural characters and mating system. Sydowia 44: 55-65.

Petersen, R.H. 1992c. Further notes on mating systems in *Melanotus*. Mycotaxon 45: 331-341.

Petersen, R.H. 1993. Cultural characters and asexual reproduction as aids in separating genera of pleurotoid fungi. Inoculum 44(2): 53 (abstract).

Petersen, R.H. 1995a. There's more to a mushroom than meets the eye: mating studies in the Agaricales. Mycologia 87: 1-17.

Petersen, R.H. 1995b. Contributions of mating studies to mushroom systematics. Canad. J. Bot. 73 (Suppl. 1): S831-S842.

Petersen, R.H., and J. Cifuentes. 1994. Notes on the mating systems of *Auriscalpium vulgare* and *A. villipes*. Mycol. Res. 98: 1427-1430.

Petersen, R.H., and S.A. Gordon. 1994. Mating systems in Hymenomycetes: new reports and new species. Mycologia 86: 743-757.

Petersen, R.H., and R.E. Halling. 1993. Mating behavior in the Xerulaceae: *Oudemansiella*. Trans. Mycol. Soc. Japan 34: 409-421.

Petersen, R.H., and S.C. McCleneghan. 1996. Reports on long-distance sexual compatibility in Agaricales. Nordic J. Bot. (in press).

Petersen, R.H., and A.S. Methven. 1994. Mating systems in the Xerulaceae: *Xerula*. Canad. J. Bot. 72: 1151-1163.

Petersen, R.H., and G.S. Ridley. 1996. A new Zealand *Pleurotus* with multiple-species compatibility. Mycologia (in press).

Petersen, R.H., and Q. Wu. 1991. *Auriscalpium vulgare*: mating system and biological species. Mycosystema 4: 25-31.

Rehner, S. A. 1989. Systematics, mating compatibility, and ribosomal DNA variation in *Agrocybe* section *Pediades*. Ph.D. dissertation, ined., Univ. Washington, Seattle. 92 pp.

Shimomura, N., K. Hasebe, Y. Nakai-Fukumasa, and M. Komathu. 1992. Intercompatibility between geographically distant strains of shiitake. Rept. Tottori Mycol. Inst. 30: 26-29.

Smith, A.H. 1947. North American species of *Mycena*. Univ. Michigan Press, Ann Arbor, MI. 521 pp.

Steglich, W., and O. Sterner. 1988. Isolierung von Sesquiterpenoiden aus der Becherkoralle, Artomyces pyxidatus (Clavicoronaceae). Zeitschr. Mykol. 54: 175-177.

Sterner, O., R. Bergman, J. Kihlberg, and B. Wickberg. 1985. The sesquiterpenes of Lactarius vellereus and their role in a proposed chemical defense system. J. Nat. Prod. 48: 279-288.

Terra, P. 1953. Détermination de la polarité sexuelle de trente espèces de Basidiomycetes saprophytes. C.R. Hebd. Sceances Acad. Sci. 236: 115-117.

Vandendries, R. 1933. Nouvelles investigations dans le domaine sexuel des Hyménomycètes. Bull. Soc. Myc. France 49: 130-165.

Wu, Q. 1991. Systematics in the genus Clavicorona (Basidiomycetes, Fungi): morphology, incompatibility, and phenoloxidase enzymes. Ph.D. dissertation, ined., Univ. Tennessee, Knoxville. 203 pp.

Wu, Q., and R.H. Petersen. 1992. A new species of Clavicorona from Japan. Mycotaxon 45: 123-129.

Wu, Q., K.W. Hughes, and R.H. Petersen. 1995. A re-evaluation of taxa of Clavicorona subg. Ramosa based on morphology, compatibility, and laccase electrophoretic patterns. Sydowia 47: 89-124.

MYCOTAXON

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AUSTROCENANGIUM gen. nov. FROM SOUTHERN SOUTH AMERICA

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ABSTRACT

A new genus of Helotiales is proposed, characterised by subperidermal stromata from which apothecia arise, and which contain conidiogenous locules. Apothecia are blackish, erumpent, and have asci containing ellipsoidal phaeospores. The anamorph has conidiomata with dark conidia and is assigned to *Endomelanconium* Petrak. The genus contains *Austrocenangium australe* (Speg.) Gamundí *comb. nov.* (type species) and *A. nanum* (E.K. Cash) Gamundí *comb. nov.*

INTRODUCTION

When Spegazzini (1887:269) described *Cenangium australe* he doubtfully included it in *Cenangium* Fr., commenting: "Species fabrica naturaque fere Bulgarieis adscribenda, vegetatione tamen cenangioidea donata. A melius novum genus?".

Later, Saccardo (1889:554) transfered *C. australe* to *Dermatea* Fr. (*Dermea* Fr.).

Groves (1946:413) considered *C. australe* Speg. under "Doubtful or Excluded species" in his monograph on *Dermea*, noting that from Spegazzini's original description it was clearly distinct from *Dermea*.

Gamundí (1986:112) excluded the species from the Dermateaceae, based on the encoelioid structure of the fructification, but its taxonomic placement was not defined.

Examination of the original collections of *C. australe* revealed dark ascospores and conidiogenous locules at the base of stromata; this latter character was missed by previous authors. The possession of dark ascospores suggests a possible relationship with *Phaeangium* (Sacc.) Sacc., a genus containing species distinguished from *Cenangium* by Saccardo (1902) because of their dark spores. However, the name is a later homonym of *Phaeangium* Pat. (Patouillard, 1894), a genus of the Pezizales, Otideaceae. On the other hand, Nannfeldt (1932:92) did not accept *Phaeangium* (Sacc.) Sacc. stating that it gathers "heterogeneous elements", probably referring to the species included by Saccardo (1899:556) in *Cenangium* subgenus *Phaeangium* Sacc., later elevated by him to the cathegory of genus. They were: *P. phaeosporum* (Cooke) Sacc. & Sydow, considered a synonym of *Velutarina rufo-olivacea* (Alb. & Schwein.:Fr) Korf; *P. tetrasporum* (Ellis) Saccardo & Sydow, which is a *Dermea* ; *P. punctoideum* (Cooke) Sacc. & Sydow, which is a *Tympanis* Fr.; *P. lignicolum* (Preuss) Sacc. & Sydow, which is a *Cenangium*. Therefore, for nomenclatural and taxonomic reasons *Phaeangium* (Sacc.) Sacc. is unacceptable. It is generally accepted that *Phaeangium* (Sacc.) Sacc. is a synonym of *Pezicula* Tul. & C. Tul. (Eriksson & Hawksworth, 1993:219).

Sphaerangium Seaver *nov. nom*. (1951:308) was created to replace "in part." *Phaeangium* (Sacc.) Sacc., with a designated type species: *Dermatea tetraspora* Ellis. It is not a new name (Art. 3, ICBN, 1994), since the type species is not the type of *Phaeangium* (Sacc.) Sacc. (*P. rubi* (Bäuml.) Sacc. & Sydow *fide* Nannfeldt (1932:92). It should be considered a new genus. As there is no latin diagnosis, *Sphaerangium* Seaver must be rejected as a "nomen nudum".

Finally, *Pezicula* Tul. & C. Tul has bright colored apothecia, hyaline ascospores and conidia, with a *Cryptosporiopsis* Bubák & Kabat. anamorph. This is not the case in *Cenangium australe* Speg.

Not finding a genus to accomodate Spegazzini's species, a new one is proposed here.

METHODS

Methods here employed are the same as described in Gamundí and Giaiotti (1994).

DESCRIPTION

AUSTROCENANGIUM Gamundí *gen. nov.*

Stromata cortice innata sparsa vel laxe gregaria, primo periderme tecta, dein ex fissis erumpentia, elliptica, carbonacea. Apothecia stromate nascentia, discoidea vel turbinatae, fusco-nigra, saepe confluentes, glabra *vel furfuracea. Hymenio in KOH viridescens. Asci octospori, cylindrici. Paraphyses filiformes, ad apicem fuscae. Ascosporae ellipticae, unicellulares, raro uniseptatae, olivaceae vel fuscae, ellipsoideae, laeves, crasse tunicatae. Loci conidiogeni in stromata irregulariter distributis. Conidia unicellularia, fuscae. Lignicola.* ***Endomelanconium*** *anamorphosis. Typus:* ***Cenangium australe*** *Speg.*

Stromata subperidermal, pulvinate, at first covered by bark, then erumpent through oval slits, black, carbonaceous. **Apothecia** arising in groups from the stroma, discoid to turbinate, blackish-brown to dark violaceous-brown, glabrous to furfuraceous, sometimes confluent. **Hymenium** turning greenish with KOH. **Asci** 8-spored. **Paraphyses** filiform, containing blackish to dark brown pigment at the apex. **Ascospores** ellipsoidal, unicellular, rarely uniseptate, olivaceous to brown, smooth, with a thick wall. **Conidiomata** eustromatic, subperidermal, irregularly multilocular, conidiogenous locules arising in the same stroma as the apothecia. **Conidia** ellipsoidal, unicellular, dark.

Anamorph. ***Endomelanconium*** Petrak, Ann. Mycol. **38**:206. 1940.

Type. *Cenangium australe* Speg., Bol. Ac. Nac. Cienc. Córdoba **11**(2):269. 1887.

Ethymology: *austro* from *australis* = southern and *Cenangium*.

Austrocenangium is proposed to cover two species, which are keyed out here:

A. Apothecia sessile; ascospores always unicellular, olivaceous, 16-24 x 7-14 µm; asci 160-180 x 14-16 µm.. ***A. australe***

AA. Apothecia stipitate; ascospores unicellular, occasionally 1-2 septate, brown, 10-13.4 x 4.8-6.2 µm; asci 108-126 x 7.2-9.6 µm.... .... ***A. nanum***

Austrocenangium australe (Speg.) Gamundí *comb. nov*. (Fig. 1-9).

= *Cenangium australe* Speg., Bol. Ac. Nac. Cienc. Córdoba **11**(2):269. 1887 *non C. australe* Pat. Bull. Soc. Myc. Fr. **11**:219. 1895.
= *Dermatea australis* (Speg.) Sacc., Syll. Fung. **8**:554. 1889.

Stroma subperidermal, pulvinate, carbonaceous, then erumpent through the bark by navicular slits. **Apothecia** 0.5-1 mm diam., coriaceous, arising from the stroma, blackish to dark violaceous brown, pulvinate, sessile with an obtuse margin; receptacle furfuraceous, diffusing a brown pigment when mounted in KOH. **Hymenium** turning greenish in the upper portion with

KOH. **Subhymenium** of *textura porrecta*, with hyphae parallel to the substrate. **Asci** 8-spored, cylindrical, obtuse at the apex, (90)160-180 x (10)14-16(18) µm. **Paraphyses** filiform or slightly swollen at the apex to 3-4 µm diam. and fuligineous, longer than asci. **Ascospores** obliquely uniseriate, unicellular, ellipsoidal, olivaceous at maturity, with a thick wall, finally 2-guttulate, 16-24 x 7-14 µm. **Ectal excipulum** 50-75 µm thick, of *textura globulosa*, with external cells 5-12 µm diam, totally black, forming conical or hemispheric mounds. **Medullary excipulum** well developed, of *textura intricata*, formed of hyaline hyphae intermixed with fascicles of dark hyphae. **Stroma** with a microstructure similar to the apothecial excipulum, with conidiogenous locules disposed irregularly, lined with a palisade of solitary conidiogenous cells. **Conidiogenous cells** holoblastic, discrete, hyaline, lageniform, 9-12 x 2.5-4.5 µm, intermixed with sterile filaments. **Conidia** solitary, unicellular, ovoid to limoniform, multiguttulate, olivaceous, 12-13 x 9-10 µm.

Conidial state. ***Endomelanconium*** Petrak.

Habitat. Lignicolous, on fallen, decayed branches of *Nothofagus betuloides*.

Material examined. Argentina, Tierra del Fuego, "Fagus (Nothofagus), Fuegia tota" and Chile, "Agaia, Hoste Island, Fagi (Nothofagi) betuloidis", in summer and winter 1882, leg. C. Spegazzini, LPS 28065.

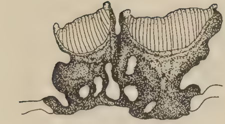
Under the same number (LPS 28065) there are two envelopes containing material: one from Hoste Island and other from Fuegia. Spegazzini (1887:269) in the original description stated:"vulgata ad ramos dejectos putrescentes Fagi betuloidis in sylvis in Staten Island et Fuegia, aest. et hiem. 1882". As the collection from Hoste Island is not cited in the protologue, the collection from "Fuegia tota" is selected here as lectotype, because it is in complete agreement with the protologue and the material is well preserved.

Lectotype. Argentina, Tierra del Fuego, leg. C. Spegazzini, summer and winter 1882, on fallen branches of *Nothofagus betuloides*, LPS 28065 a.

According to Spegazzini (1887:269), asci are "iodo ope tunica ascorum apice dilute violaceo-coerulescit". I was unable to discern this reaction in my mounts.

Austrocenangium australe (Speg.)Gamundí. (Lectotype, LPS 28065 a).

1. Sketch of a vertical section of a stroma with conidiogenous locules and apothecia.- 2. Vertical section of a stroma with conidiogenous locules (cl).- 3. Conidiogenous layer.- 4. Vertical section of an apothecium. - 5. Detail of B. in 4.- 6. Detail of the ectal excipulum.- 7. Ascus and paraphyses.- 8. Ascospores.- 9. Conidia.- cl, conidiogenous locules; em, medullary excipulum; h, hymenium; sh, subhymenium.



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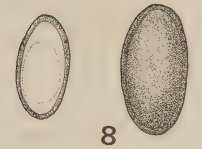

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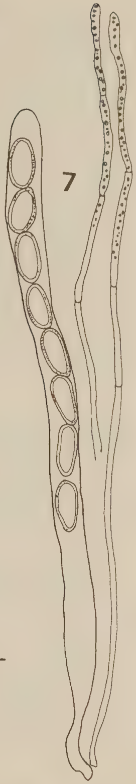

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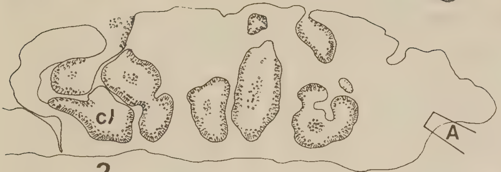

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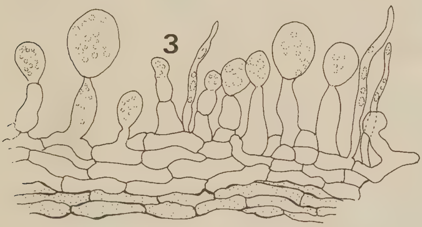

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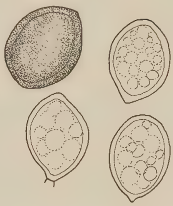
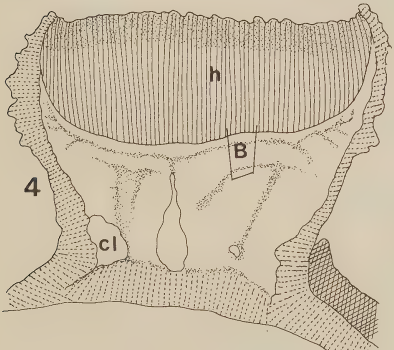


9

1 500 μm 2 300 μm
3 10 μm 4 250 μm
5 50 μm
6 10 μm
7 50 μm
8 20 μm
9 10 μm



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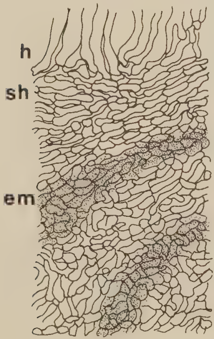

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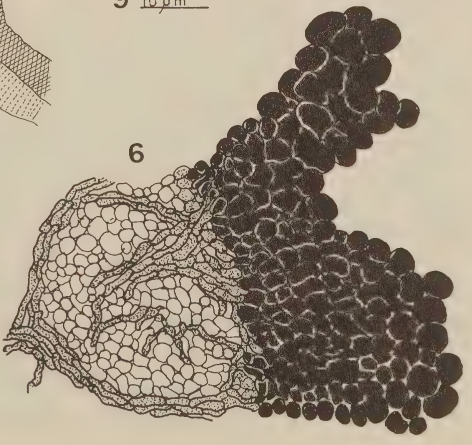

6

No mention is made of the conidial state in the original description, although conidiogenous locules and conidia are evident when a stroma with apothecia is sectioned vertically (see fig. 2, 4). Conidiomata are similar to those of *Bulgaria nana* Cash (Cash, 1957). These were described by Gamundí & Arambarri (1983:19) as *Endomelanconium nanum*, establishing the connection between teleomorph and anamorph, both in the same stroma. Based on this finding, Hawksworth *et al.* (1995:149) recorded this connection.

The conidial state was identified by comparison with *Endomelanconium pini* (Corda) Petrak, type species of *Endomelanconium* Petrak, through examination of material from England, leg. & det. B. Sutton, XII-1970, on branches of *Abies pectinata*, IMI 200695. E. *pini* is the only species described for the genus withouth any recorded teleomorph.

Austrocenangium nanum (Cash) Gamundí *comb. nov.*
= *Bulgaria nana* Cash, Sydowia, Beih. I: 289. 1957; Gamundí & Arambarri, Rev. Fac. Agronomía, Univ. Nac. La Plata, **59**(1-2):18. 1983.

Holotype: Chile, Valdivia, Corral, leg. R. Thaxter, XII-1905, on bark of indet. tree with compound leaves, (BPI). Examined.

Illustration: Gamundí & Arambarri (1983, p. 22: fig. 1-9; p. 23: fig.1-2).

There is no doubt that *A. nanum* and *A. australe* are congeneric. The main differences are presented in the key. It can be added that *A. nanum* has more gelatinous apothecia, while those in *A. australis* are more coriaceous.

DISCUSSION

The closest genera to *Austrocenangium* having blackish apothecia and ellipsoidal ascospores are *Cenangium* Fr. and *Dermea* Fr., but in both genera spores and conidia are hyaline. *Cenangium* anamorphs are ascribed to *Dothichiza* Lib. & Roumeg. and *Xenostroma* Hoehnel; those of *Dermea* to *Foveostroma* Di Cosmo (= *Micropera* Lév.) (Hennebert & Bellemère, 1979).

Austrocenangium, also shows affinity to *Ameghiniella* Speg., but in that genus the ascospores are hyaline, the apothecia more robust, and there is no known conidial state.

Austrocenangium, because of its affinities with *Cenangium*, can be included in the ***Helotiaceae*, *Encoelioideae*** but is also close to *Dermea*, a genus placed in the ***Dermateaceae***. The type species of *Dermea -D. cerasi* (Pers.: Fr.) Fr.- had been included in *Cenangium* by Fries himself (Fries, 1822:179), and it also happened with other species of *Dermea* (Groves, 1946). *Austrocenangium* represents a critical case in the present delimitation of the families. It was suggested by Spooner (Raitviir & Spooner, 1994:405) that "most of the recognized families (in the Leotiales) are unnatural and require further study at all levels".

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BIBLIOGRAPHY

CASH, E. K. 1957. Some Chilean Discomycetes collected by Roland Thaxter. Sydowia Ser. II, Beih. I.:289-293.

ERIKSSON, O. & D. L. HAWKSWORTH, 1993. Outlines of the Ascomycetes. 1993. Syst. Ascom. **12**:51-257.

FRIES, E. 1822. Systema Mycologicum **2**(2). Lund.

GAMUNDÍ, I. J. 1986 [1987]. Fungi, Ascomycetes, Cyttariales, Helotiales: Geoglossaceae, Dermateaceae in Guarrera, S.A., Gamundí de Amos, I. & Rabinovich de Halperín, D. (Eds.), *Flora Criptogámica de Tierra del Fuego*, **10**, fasc. 4:1-126. CONICET, Buenos Aires.

GAMUNDÍ, I. J. & A. M. ARAMBARRI, 1983. Bulgaria nana Cash y su anamorfo Endomelanconium (Helotiaceae, Ombrophiloideae). Rev. Fac. Agron. Univ. Nac. La Plata **59**:17-23.

GAMUNDÍ, I. J. & A. L. GIAIOTTI, 1994. Notas sobre Discomycetes andino-patagónicos I. Arachnopeziza Fuckel y Parachnopeziza Korf. Sydowia **46**(1):12-22.

GROVES, J. W. 1946. North American species of Dermea. Mycologia **38**(4):351-431.

HAWKSWORTH, D. L., P. M. KIRK,, B. C. SUTTON, & D. N. PEGLER, 1995. Ainsworth & Bisby's Dictionary of the Fungi. 8th. Ed. 616 pp. CAB International, Wallingford, Oxon.

HENNEBERT, G. L. & A. BELLEMÈRE, 1979. Les formes conidiennes des Discomycètes. Essai Taxonomique. Rev. Mycol. (Paris) **43**:259-315.

NANNFELDT, J. A. F. 1932. Studien über die Morphologie und Systematik der nicht-lichenisierten Inoperculaten Discomycetes. Nova Acta Reg. Soc. Scient. Upsaliensis Ser. IV, **8**(2):1-398, Taf. I-XX.

PATOUILLARD, N. 1894. Les Terfèz de la Tunisie. Journ. Bot. 3ème. Année, No. 10:153-156.

PETRAK, F. 1940. Mykologischen Notizen XIII. Ann. Mycol. **38**:181-267.

RAITVIIR, A. & B. M. SPOONER, 1994. Discussion 8: Cyttariales, Lahmiales, Leotiales, Ostropales, Patellariales, Rhytismatales and Triblidiales in Hawksworth, D. L. (Ed.), Ascomycetes: Systematic, Problems and Perspectives in the Nineties, 453 pp. Plenum Press, N. York.

SACCARDO, P. A. 1889. Sylloge Fungorum **8**. Patavii.

SACCARDO, P. A. 1902. Sylloge Fungorum **16**. Patavii.

SEAVER, F. J. 1951. The North American Cup-fungi: Inoperculates. 428 pp. N. York.

SPEGAZZINI, C. 1887. Fungi Fuegiani. Bol. Ac. Nac. Cienc. Córboba **11**(2):321-404.

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COMPARATIVE STUDY OF CELLULOLYTIC ENZYME ZYMOGRAMS OF SPECIES OF *THECOTHEUS* AND *IODOPHANUS* (PEZIZALES-ASCOMYCETES)

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ABSTRACT

Twenty one strains belonging to ***Iodophanus carneus, Thecotheus pelletieri*** and ***T. agranulosus*** from diverse locations of Argentina were analysed on the basis of cellulose isozyme patterns and cultural characters. The results of this study support the use of cellulase isozymes as a tool in the taxonomy of this group.

Key words: isozymes, cellulases, Pezizales, taxonomy, fungi.

INTRODUCTION

The family Ascobolaceae (Ascomycetes-Pezizales) includes many species whose characteristic habitat is the dung from plant eating animals. This substrate is composed mainly by lignocellulosic remains. These fungi possess, therefore, an extracellular multienzymatic system, capable of thoroughly degrading the crystalline cellulose to glucose units, which they can use as energetic substrate.

Boudier (1869) recognised within the family Ascobolaceae the subfamily "Ascoboli spurii" (afterwards knows as Pseudoascobolaceae) and placed in it those species which present hyaline ascospores. Thus he created the genera ***Ascophanus*** (with 8-16 ascospores per asci), ***Thecotheus*** (with 32 ascospores per asci) and ***Rhyparobius*** (with numerous ascospores per asci). Since then, many genera have been introduced, using traditional morphological characters.

Korf (1954) considers that ***Ascophanus*** must be split into three different genera, keeping the generic name ***Ascophanus*** "sensu stricto" for those species whose asci give an amyloid reaction with Melzer's reagent. The genus ***Ascophanus*** was typified with ***A. subfuscus*** (Cr. & Cr.) Boud. which has unamyloid asci. Therefore, Kimbrough and Korf (1967) have proposed a new genus: ***Iodophanus*** Korf, typified with ***Iodophanus carneus*** (Pers. : Pers.) Korf, including in it species with amyloid asci, spores with callose-pectic exosporium and without apiculum.. They placed ***Iodophanus*** and ***Thecotheus*** (with amyloid asci but ascospores with apiculum) to the tribe Pezizeae from the family Pezizaceae.

Later on, Korf (1972) puts ***Thecotheus*** into the tribe Iodophaneae, within the Ascobolaceae. This genus is related to ***Iodophanus***, because many species representing both possess similar morphological and biochemical characters which match those used to define the Ascobolaceae family.

Kimbrough (1994) points out that "the family position of ***Iodophanus*** and ***Thecotheus*** in Pezizales have been in question. Some authors retain both genera within the Ascobolaceae (Brumelen, 1967; Korf, 1973; Dennis, 1978) while others consider them among the Pezizaceae (Kimbrough and Korf, 1967; Rifai, 1968; Kimbrough et al., 1969)".

Kimbrough and Curry (1985) examined septal structures in asci, ascogenous hyphal, paraphyses and excipular cells of species of ***Ascobolus***, ***Saccobolus***, ***Thecotheus*** and ***Iodophanus***. All species of ***Ascobolus***, ***Saccobolus*** and ***Thecotheus*** possess a semihespherical septal structure similar to that found by Wells (1972) wich was defined as the "ascoboloid type", while in the ***Iodophanus*** species a "pezizoid type" of septal structure was found. The biconvex bands in the septal pore of asci and ascogenous hyphae of ***Iodophanus spp.*** are similar to those found in species of ***Peziza*** (Schrants, 1970; Curry and Kimbrough, 1983). Therefore, they conclude that ***Iodophanus*** should be considered a member of the Pezizaceae. In contrast, ***Thecotheus*** should be retained in the Ascobolaceae in agreement with Boudier's (1969) original concept of that family.

Taking into account, that the comparison of the patterns of those enzymes with identical catalytic function, can lead us to conclusions dealing with their homologies, and provide additional information on differences or similarities that back up those conclusions based on morphological observations, we have faced in this work the electrophoretic study of the cellulolytic enzymes [endoglucanase (1,4-ß-D-glucan 4- glucanohydrolase) (EC 3.2.1.4), and ß-glucosidase (ß-D-glucoside glucohydrolase) (EC 3.2.1.21)] from ***Iodophanus carneus*** (Pers. : Pers.) Korf, ***Thecotheus pelletieri*** (Cr. & Cr.) Boud and ***Thecotheus agranulosus*** Kimbrough, with the aim of clarifying their taxonomic place and their probable phylogenetic relationship.

MATERIAL AND METHODS

Organisms: Table 1 shows location (place, province) (BA: Buenos Aires, CD: province of Córdoba, PBA: province of Buenos Aires, RN: province of Río Negro, TF: province of Tierra del Fuego), substrate (dung), date of collection, and strain number (BAFC #) of all isolates. The different strains were kept on PF medium (Gamundí and Ranalli, 1964) at 5°C. BAFC: Buenos Aires Faculty of Sciences.

Growth medium: $SO_4Mg.7H_2O$, 0.5 g; K_2HPO_4, 0.6 g; KH_2PO_4, 0.5 g; $CuSO_4.5H_2O$, 0.4 mg; $MnCl_2.4H_2O$, 0.09 mg; BO_3H_3, 0.07 mg; Na_2MoO_4, 0.02 mg; $FeCl_3$, 1 mg; $ZnCl_2$, 10 mg; thiamine-HCl, 0.1 mg; microcrystalline cellulose (Sigmacell Type 20, Sigma), 10 g; asparagine, 4 g; bidistilled water to complete 1 l.

The growth media were sterilized at 121°C and 1.2 atm for 20 min; except for the nitrogen source and the thiamine stock solution, which were filter sterilized separately.

Erlenmeyer flasks (125 ml) containing 50 ml of fresh medium were inoculated by transferring a 3-mm plug cut out from the margin of a 5-day-old-colony grown on 2 % Bactoagar. Incubation was carried out at 23 °C under continuous light and orbital shaking at 125 *rpm* in an incubator chamber -New Brunswick G-27. The mycelium was harvested on the 10th day of culture for ***Thecotheus pelletieri*** and ***T. agranulosus*** and on the 8th day for ***Iodophanus carneus***, except in the case of growth curves measurements. The culture solids (i.e. mycelium plus undegraded cellulose) were taken off by vacuum filtration in a Buchner funnel through filter paper. The culture solids retained on the filter paper were rinsed twice with bidistilled water, dried at 70°C overnight, weighed, milled and kept at -20°C.

The culture supernatants were stored at -20°C and used as extracellular enzyme source.

For total enzyme assays (extracellular and hyphae-associated) the following procedure was used: 0.3 % w/v Triton X-100 and 10 *mM* $NaHCO_3$ were added to the Erlenmeyer flasks which were then homogenized with an Omni 5000 homogeneizer. After centrifugation for 20 min at 1000 x *g* the pellet was discarded and the supernatant stored at -20°C, and used as total enzyme source.

Table 1. List of strains used in this study.

Strain Key	Species	Location	Substrate	Date	BAFC #
rol	***Iodophanus carneus***	Adrogué, PBA	cow	07/60	2533
ocs	***Iodophanus carneus***	Cañada del Sauce, CD	cow	04/92	2540
olg	***Iodophanus carneus***	Los Gigantes, CD	cow	04/92	2597
vfa	***Iodophanus carneus***	Ciudad Universitaria, BA	cow	08/94	2599
nt1	***Iodophanus carneus***	Campana, PBA	cow	07/94	2603
1ch	***Iodophanus carneus***	Campana, PBA	cow	07/94	2620
ntv	***Iodophanus carneus***	Campana, PBA	cow	07/94	2623
tpa	***Thecotheus pelletieri***	Bariloche, RN	cow	01/88	2062
tpb	***Thecotheus pelletieri***	Bariloche, RN	cow	01/88	2063
tp1	***Thecotheus pelletieri***	Campana, PBA	cow	07/94	2073
tp2	***Thecotheus pelletieri***	Campana, PBA	cow	07/94	2077
tp3	***Thecotheus pelletieri***	Campana, PBA	cow	07/94	2081
tp4	***Thecotheus pelletieri***	Campana, PBA	cow	07/94	2088
tp5	***Thecotheus pelletieri***	Campana, PBA	cow	07/94	2089
e03	***Thecotheus agranulosus***	Bahía Ensenada, TF	horse	03/94	2090
e04	***Thecotheus agranulosus***	Bahia Ensenada, TF	horse	03/94	2060
e05	***Thecotheus agranulosus***	Bahía Ensenada, TF	horse	03/94	2059
e06	***Thecotheus agranulosus***	Bahía Ensenada, TF	horse	03/94	2055
e10	***Thecotheus agranulosus***	Bahía Ensenada, TF	horse	03/94	2054
e12	***Thecotheus agranulosus***	Bahía Ensenada, TF	horse	03/94	2052
e13	***Thecotheus agranulosus***	Bahía Ensenada, TF	horse	03/94	2045

Growth estimation

Mycelial proteins: Dried culture solids were hydrolyzed with 1 *N* NaOH for 30 min at 100°C. The samples were then centrifuged for 20 min at 1000 x *g*, and the proteins present in the supernatant were measured by the Bradford method (1976) with bovine serum albumin in 1 *N* NaOH as standard.

Cellulose degradation

The pellet which resulted from the alkalyne hydrolysis (mycelial proteins determination) was rinsed twice with bidistilled water, centrifuged for 20 min at 1000 x *g* and hydrolysed with glacial acetic acid : nitric acid : bidistilled water (10 : 1 : 1) for 40 min at 90 °C. After rinsing, the remaining solids were resuspended in bidistilled water, vacuum filtered in a Buchner funnel, dried at 70°C overnight and weighed. The dry residue present on the filter paper corresponds mainly to undegraded cellulose during the culture period (Mercuri, 1987).

Enzyme assays

Different dilutions of culture supernatants, directly obtained after filtration (extracellular enzyme), or after the extraction procedure described above (total enzyme), were used as enzyme sources.

Endoglucanase: 400 µl of carboximethylcellulose (CMC) (sodium salt high viscosity; Sigma; 5 mg/ml in 0.1 *M* pH 4.8 sodium acetate buffer) were mixed with 100 µl of an appropiate dilution of the enzyme, at 50 °C; during a period of time (5-30 min) which varied each time. Reducing sugars were measured by the Somogyi-Nelson method (Somogyi, 1952; Nelson, 1944) with glucose (glc) as the standard.

Unit of activity: a unit of enzyme activity was defined as the amount of enzyme required to liberate 1 nmol/min. of reducing sugars expressed as glc equivalents.

ß-glucosidase: 900 µl of p-nitrophenyl-ß-D-glucopyranoside (Sigma, 0.2 mg/ml in 0.1 *M* pH 4.8 sodium acetate buffer) were mixed with 100 µl of an appropiate dilution of the enzyme, at 50 °C; during a period of time (5-30 min) which varied each time. The reaction was stopped by adding 2 ml of 0.1 *M* pH 9.8 Clark-Lubs buffer (50 ml of 0.1 *M* H_3BO_3 in 0.1 *M* KCl and 40.8 ml of 0.1 *N* NaOH taken to a final volume of 100 ml with bidistilled water) and the absorbance was read at 430 nm.

Unit of activity: a unit of enzyme activity was defined as the amount of enzyme required to liberate 1 nmol/min of p-nitrophenol.

Endoglucanase zymograms.

The different strains of ***Iodophanus carneus***, were grown for 8 days, while those of ***Thecotheus agranulosus*** and ***T. pelletieri***, were grown during 10 days in order to obtain the culture supernatants. For ***I. carneus*** the supernatant corresponded to the total enzyme fraction, due to the low extracellular enzyme recovery. All supernatants were liophylized and resuspended in the sample buffer [1.5% w/v Tris; 1 *N* HCl, 12 % v/v; 1 % w/v bromophenol blue, 10 µl; 20 % v/v glycerol; 5 % w/v SDS (pH 6.8)].

Twenty µl of each sample, containing 0.5 U of endoglucanase were loaded in 8 % SDS-polyacrylamide gels. Electrophoretic runs were made vertically in denaturing conditions.

For the endoglucanase isozymes detection an overlay (10 mm in width) containing 0.1% CMC (sodium salt high viscosity; Sigma) and 2 % Bactoagar was placed over the gel. They were both left for 1 h at 50 °C. Finally, the overlay was immersed in a solution of 0.1 % Congo Red for 15 min, after which it was rinsed in 1 *N* NaCl. The bands with enzymatic activity were observed as clear zones, due to CMC digestion, over a red background (Béguin, 1983; Coughlan, 1981). For each isozyme the Rf was determined as the ratio between the migration distance of the enzyme with respect to the front of bromophenol blue.

ß-glucosidase zymograms.

The gel preparation, as well as the conditions for electrophoretic run and rinse of SDS, were the same as those for the endoglucanase zymograms, except that the gel used was 5 % polyacrylamide and 4 U of ß-glucosidase were loaded.

After rinsing the SDS, the gel was immersed in a solution of 20 mM p-nitrophenyl-ß-D-glucopyranoside (Sigma) in 0.1 *M* pH 4.8 sodium acetate buffer. After an incubation time of 1 h at 50 °C, the gel was transferred into 0.1 *M* pH 9.8 Clark-Lubs buffer. The bands with enzymatic activity appeared as yellow spots over a transparent background. For each isozyme, the Rf was determined as the ratio between the migration distance with respect to the front of bromophenol blue.

Molecular weight markers.

For all gels, molecular weight markers (Sigma Kit) were loaded. For the endoglucanase zymograms the following markers were used: carbonic anhydrase (monomer, mol wt 29 KD), chicken egg albumin (monomer, mol wt 45 KD), bovine serum albumine (monomer, mol wt 66 KD). For those of ß-glucosidase, urease (trimer, mol wt 272 KD) was used.

After the electrophoretic run, the tracks containing the molecular weight markers were immersed in a protein fixing solution (40 % v/v methanol, 10% v/v acetic acid) overnight. Then the gel was transferred to the staining solution (0.25 % w/v Coomasie brillant blue R-250, 50 % v/v methanol, 10 % v/v acetic acid; this solution diluted to 1:50 with the protein fixing solution) overnight. Finally, it was immersed in the decoloring solution (20% v/v methanol, 5 % v/v acetic acid) overnight, after which it was left in 7 % acetic acid .

Statistics.

All results presented are the average of three independent experiments (each in triplicates), with a standard error (SEM) of less than 5%. The data were analyzed by the one-way ANOVA followed by Tukey-Kramer´s multiple comparison test ($p<0.05$). In the case of the comparison of total endoglucanase activity within the species, the Kruskal-Wallis´s non parametric ANOVA test ($p<0.05$) was used. For the comparison of total ß-glucosidase activity between the species ***Thecotheus pelletieri*** and ***T. agranulosus***, the Mann-Whitney´s non parametric test ($p<0.05$) was used.

RESULTS

Figure 1 shows the growth kinetics and cellulase production of ***Iodophanus carneus*** (rol strain), ***Thecotheus pelletieri*** (tp2 strain), and ***T. agranulosus*** (e03 strain). It can be observed that in the case of ***I. carneus***, maximum growth, cellulose degradation and enzyme production were achieved on the 8th day. The endoglucanase activity, in the case of ***I. carneus***, belongs to the total enzyme fraction, because the enzyme activity recovery in the supernatant (extracellular enzyme) was very low. Therefore, in the case of ***I. carneus***, practically all the endoglucanase activity is associated to the fungal mycelium. For the ß-glucosidase, its enzyme was not detected either in the supernatant or in the total enzyme fraction. This enzyme was only found in the pellets obtained from the crude lysates of the cultures. As it was not possible to extract it with Triton X-100 and $NaHCO_3$, we considered that for ***I. carneus***, the ß-glucosidase is strongly attached to the hyphal walls.

For ***Thecotheus pelletieri*** and ***T. agranulosus*** maximum growth, cellulose degradation and enzyme production were achieved on the 10th day. For both species, the enzyme activity measured belongs to the supernatant fraction (extracellular enzyme), because their activity in it was high. Figure 1 is representative of all strains (for each species) used for this study.

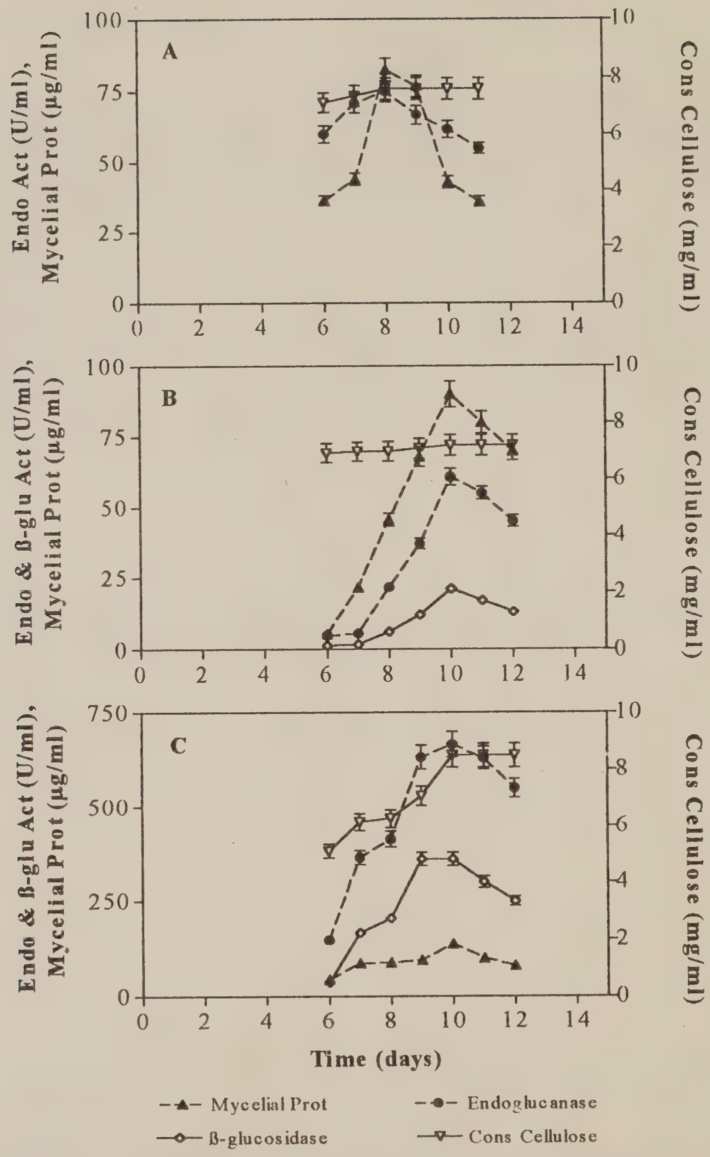

Figure 1. Growth and cellulase production by **(A)** ***Iodophanus carneus*** (strain rol);**(B)** ***Thecotheus pelletieri*** (strain tp2);**(C)** ***T. agranulosus*** (strain e03);cultured on microcrystalline cellulose. Data are the mean ± SEM (n=9).

Table 2 shows the growth data for each strain of the three different species, ***Iodophanus carneus*, *Thecotheus pelletieri***, and ***T. agranulosus***.

Table 2. Growth data of the different strains of ***Iodophanus carneus*, *Thecotheus pelletieri*** and ***T. agranulosus*** cultured on microcrystalline cellulose.

Strain Key	Mycelial Proteins (µg/ml)	Consumed Cellulose (mg/ml)	Maximal Growth Day
rol	82.6 ± 4.1^{b}	7.6 ± 0.4^{a}	8
ocs	84.4 ± 4.2^{b}	8.4 ± 0.4^{a}	8
olg	76.9 ± 3.8^{b}	7.7 ± 0.4^{a}	8
vfa	119.4 ± 6^{a}	8.4 ± 0.4^{a}	8
nt1	105.2 ± 5.3^{a}	7.5 ± 0.4^{a}	8
1ch	107.8 ± 5.4^{a}	8.3 ± 0.4^{a}	8
ntv	13.9 ± 0.7^{c}	6.3 ± 0.3^{b}	8
tpa	142.7 ± 7.1^{2}	9.4 ± 0.5^{1}	10
tpb	161.5 ± 8.1^{1}	8.7 ± 0.4^{1}	10
tp1	$159 \pm 7.9^{1,2}$	9 ± 0.5^{1}	10
tp2	136.4 ± 6.8^{3}	$8.5 \pm 0.4^{1,2}$	10
tp3	115.6 ± 5.8^{4}	7.4 ± 0.4^{2}	10
tp4	$156.3 \pm 7.8^{1,2}$	6.3 ± 0.3^{3}	10
tp5	115.6 ± 5.8^{4}	6.1 ± 0.3^{3}	10
e03	90 ± 4.5^{I}	$6.9 \pm 0.3^{II,III}$	10
e04	72.7 ± 3.6^{II}	$7.2 \pm 0.4^{II,III}$	10
e05	91.7 ± 4.6^{I}	$6.5 \pm 0.3^{III,IV}$	10
e06	52.3 ± 2.6^{III}	$7.6 \pm 0.4^{I,II}$	10
e10	88 ± 4.4^{I}	5.9 ± 0.3^{IV}	10
e12	93.6 ± 4.7^{I}	8.3 ± 0.4^{I}	10
e13	87.9 ± 4.4^{I}	$7.4 \pm 0.4^{I,II,III}$	10

$^{+}$ The data are the mean±SEM (n= 9).

$^{++}$ Diferent letters or numbers denote statistical significance between strains of the same species ($p<0.05$).

It can be observed that all strains used effectively grew on crystalline cellulose as a sole carbon source. Nevertheless, quantitative differences refering to the cellulose uptake, growth and enzyme production were observed amongst the different strains of the same species (tables 2 and 3). On the other hand, the day of maximum growth and enzyme production were constant between the different strains of the same species. When all strains were taken as a group, differences between species were significant only in the case of mycelium proteins, between ***Iodophanus carneus*** and ***Thecotheus pelletieri***; and between ***T. pelletieri*** and ***T. agranulosus***.

Table 3 shows that for all strains of ***I. carneus***, the amount of extracellular endoglucanase was below 50% of the total enzyme in all cases, therefore, we can say that for this species, this enzyme is mainly associated to the mycelium. On the contrary, both for ***Thecotheus pelletieri*** and ***T. agranulosus*** (except strain e03), more than 50% of the total enzyme belonged to the extracellular fraction.

The ß-glucosidase activity could not be recovered after extraction with Triton X-100 and $NaHCO_3$ in the different strains of ***Iodophanus carneus***, and was only detected in pellets obtained after centrifugation of the crude lysates; therefore in this species the ß-glucosidase is strongly wall associated. ***Thecotheus agranulosus***' strains presented both low and high ß-glucosidase extracellular activity. Instead, in ***T. pelletieri***, more than 50% of the total enzyme was extracellular for all strains.

The zymogram of endoglucanase characteristic of ***Iodophanus carneus***, ***Thecotheus pelletieri*** and ***T. agranulosus*** is shown in figure 2. The pattern was constant for all strains of the same species. ***Thecotheus pelletieri*** had seven bands with endoglucanase activity, while ***T. agranulosus*** had four, two of them coincided with those of ***T. pelletieri*** (Rf 0.64 and Rf 0.18). ***Iodophanus carneus***, presented three bands with endoglucanase activity, two of them common with ***T. pelletieri*** (Rf 0.49 and Rf 0.1). The band of Rf 0.1 of ***I. carneus*** was much wider than that of ***T. pelletieri***, probably due to the presence of more isozymes which were not resolved with the system used.

The zymogram of ß-glucosidase is shown in figure 3. As the ß-glucosidase of ***Iodophanus carneus*** is wall associated, and could not be extracted, it was not loaded in the gels.

Both ***Thecotheus pelletieri*** and ***T. agranulosus***, presented only one characteristic band with ß-glucosidase activity (Rf 0.27 and Rf 0.31 respectively). This pattern was also constant between strains of the same species.

Table 3. Cellulase production by the different strains of ***Iodophanus carneus***, ***Thecotheus pelletieri*** and ***T. agranulosus*** growing on microcrystalline cellulose.

Strain Key	Endo. Total (U/ml)	Endo. Extracel. (U/ml)	% of Total	ß-glu. Total (U/ml)	ß-glu. Extracel. (U/ml)	% of Total
rol	75.1 ± 3.8^{c}	14.4±0.7	19.2	ND	ND	-
ocs	29.8 ± 1.5^{d}	10.3±0.5	34.5	ND	ND	-
olg	125.5 ± 6.3^{b}	19.6±1	15.6	ND	ND	-
vfa	30.9 ± 1.5^{d}	14.4±0.7	46.6	ND	ND	-
nt1	82.3 ± 4.1^{c}	16.5±0.8	20	ND	ND	-
1ch	284 ± 14.2^{a}	24.7±1.2	8.7	ND	ND	-
ntv	10.3 ± 0.5^{e}	0	0	ND	ND	-
tpa	1333.4 ± 66.7^{1}	889±44.4	66.7	120.4 ± 6^{2}	61.7±3	51.2
tpb	975.4 ± 48.8^{2}	913.7±45.7	93.7	39.1 ± 2^{6}	20.3±1	51.9
tp1	135.8 ± 6.8^{5}	117.3±5.9	86.4	66.2 ± 3.3^{4}	38.4±1.9	58
tp2	740.8 ± 37^{3}	666.7±33.3	90	361.3 ± 18^{1}	361.3±18	100
tp3	568 ± 28.4^{4}	292.2±14.6	51.4	67.7 ± 3.4^{4}	47.4±2.4	70
tp4	111.1 ± 5.6^{6}	70±3.5	63	55.7 ± 2.8^{5}	55.7±2.8	100
tp5	84.4 ± 4.2^{7}	61.7±3	73.2	90.3 ± 4.5^{3}	50.4±2.5	55.8
e03	60.7 ± 3^{V}	60.7±3	100	48.9 ± 2.4^{III}	48.9±2.4	100
e04	$115.2\pm5.8^{III,IV}$	62.8±3.1	54.5	75.3 ± 3.8^{II}	21.1±1	28
e05	703.8 ± 35.2^{I}	109.1±5.4	15.5	144.5 ± 7.2^{I}	35.4±1.8	24
e06	55.6 ± 2.8^{V}	38.1±1.9	68.6	27.1 ± 1.3^{IV}	9±0.4	33.2
e10	125.5 ± 6.3^{III}	88.5±4.4	70.5	71.5 ± 3.6^{II}	33.1±1.6	46.3
e12	259.3 ± 13^{II}	133.8±6.7	51.6	54.2 ± 2.7^{III}	54.2±2.7	100
e13	107 ± 5.3^{IV}	55.6±2.8	51.9	69.3 ± 3.5^{II}	19.6±1	28.3

$^{+}$ The data are the mean±SEM (n= 9). $^{++}$ Diferent letters or numbers denote statistical significance between strains of the same species ($p<0.05$).
$^{+++}$ ND: not detected

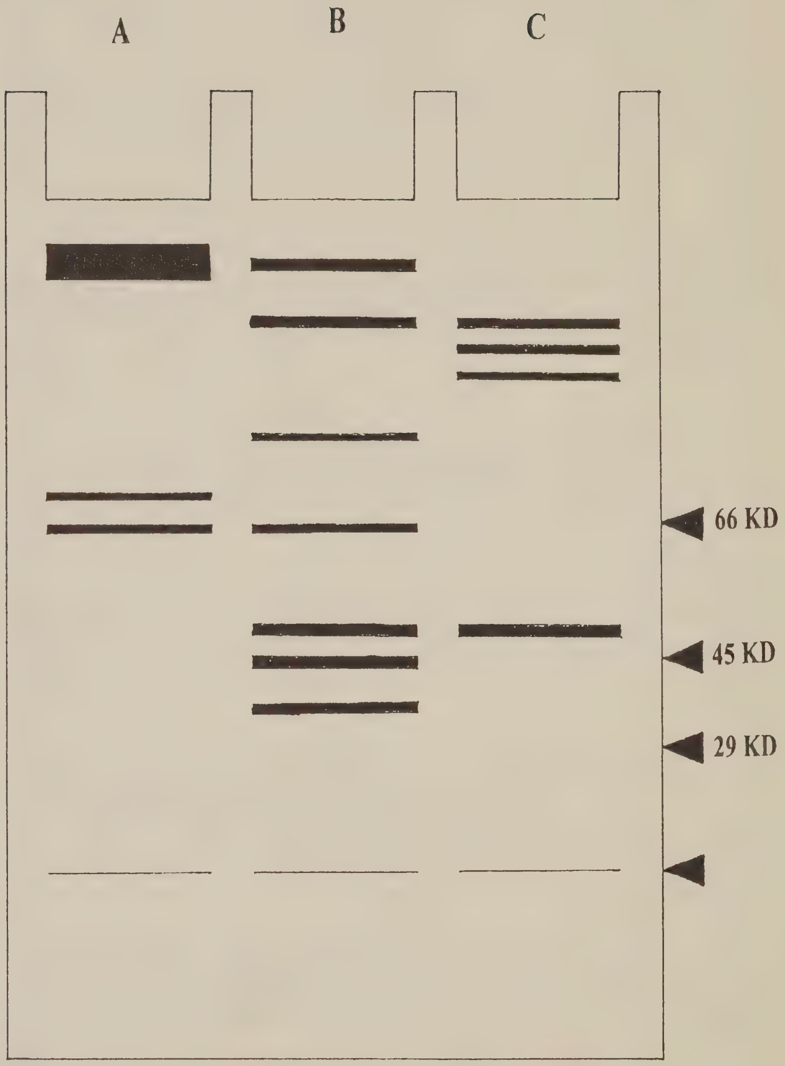

Figure 2. Zymogram of endoglucanase in 8 % SDS-PAGE, characteristic of ***Iodophanus carneus*** (line **A**), ***Thecotheus pelletieri*** (line **B**) and ***T. agranulosus*** (line **C**). The arrows indicate the electrophoretic mobility of the molecular weight markers and the front of bromophenol blue.

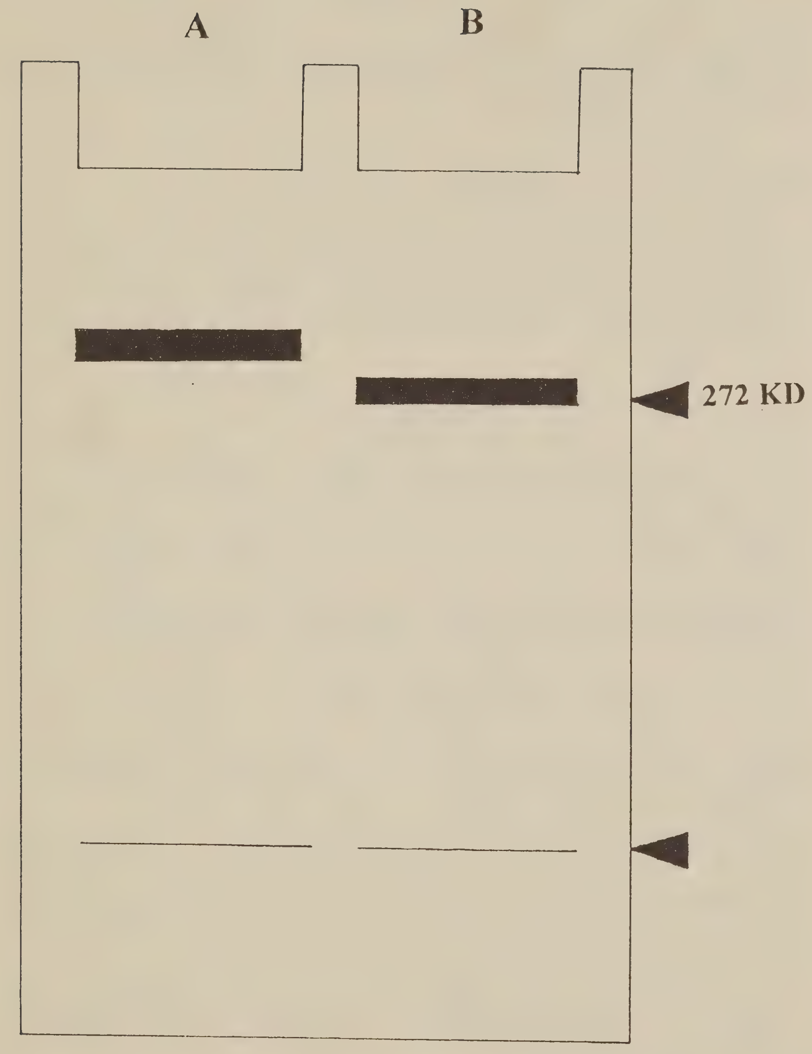

Figure 3. Zymogram of ß-glucosidase in 5 % SDS-PAGE, characteristic of ***Thecotheus pelletieri*** (line **A**) and ***T. agranulosus*** (line **B**). The arrows indicate the electrophoretic mobility of the molecular weight marker and the front of bromophenol blue.

DISCUSSION

All strains used in this study actively grew on crystalline cellulose. The electrophoretic isozyme pattern was characteristic for each species, being constant between strains.

The number of bands obtained in a zymogram, not only depends on the number of genes coding for cellulases. it can also be the result of differences in the glycosilation of a common polypeptidic chain, partial proteolysis of the enzymes or the aggregation of these (Pardo, 1995). The intraspecific variations observed were quantitative, nevertheless, no species proved to be more cellulolytic than the others. Carder (1989) found that in the genus *Verticillum*, the pattern of cellulolytic isozymes was characteristic for the species.

With regard to the localization of cellulases, we can say that for ***Iodophanus carneus*** the endoglucanase activity is mainly associated to the mycelium; either bound to their cell wall, or in a polysaccharide sheath around the hyphaes. The ß-glucosidase, instead, is strongly associated to the cell walls. On the other hand, for ***Thecotheus pelletieri*** and ***T. agranulosus*** the endoglucanase activity was mainly extracellular. The ß-glucosidase activity was also mainly extracellular for ***T. pelletieri***, while in ***T. agranulosus*** some strains had low and others high extracellular ß-glucosidase activity. It is well known that at least some cellulolytic enzymes are wall associated, or in close relation with the hyphae, in a sheath or polysaccharide matrix. This has been suggested for the white and soft rot fungi, which break down the cellulose present in the wood only to a limited distance from their hyphae (Montgomery, 1982). For the ß-glucosidase, a strong union with the fungal cell wall of ***Sporotrichum pulvurulentum*** (Eriksson, 1978) and ***Trichoderma reesei*** (Jackson and Talburt, 1988; Messner et al., 1990) was reported. The physic limitation of the cellulolytic enzymes diffusion from its producing cell can be a potencial adaptative mechanism. In this way, the efficiency in a polymeric insoluble substrate utilization such as crystalline cellulose would be optimised. When competing with other microorganisms for a carbon source, it would require the direct contact of the cells to the substrate (Tate, 1995). This adaptation could be important for ***Iodophanus carneus***, according to the cosmopolitan distribution of this species.

We conclude, from our results, that the pattern of electrophoretic cellulase isozymes mobility, together with the location of these, are useful characters to be employed in the taxonomy of this group of Ascomycetes. This backs up the role that these Pezizales play in the degradation of lignocellulosic waste from heviborous'dung. On the other hand, the location of the cellulolytic enzymes is similar between species of ***Thecotheus*** and differs markedly from that of ***Iodophanus carneus***. This species shares some bands of endoglucanase activity with ***T. pelletieri***, and the latter with ***T. agranulosus***, indicating a phylogenetic relation between them, which has already been established based on morphological characters.

ACKNOWLEDGEMENTS

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REFERENCES

BOUDIER E. (1869). Mémoire sur les Ascobolés. Ann. Sci. Nat. Bot. Ser. 10: 191-268.

BEGUIN P. (1983). Detection of cellulase activity in polyacrylamide gels using Congo Red-stained agar replicas. Anal. Biochem. 131: 333-336.

BRADFORD M.M. (1976). A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principe of protein-dye binding. Anal. Biochem. 72: 248-254.

BRUMMELEN J. VAN (1967). A world monograph ot the genera ***Ascobolus*** and ***Saccobolus*** (Ascomycetes-Pezizales). Persoonia (suppl.) 1: 1-260.

CARDER J.H. (1989). Disctintions between cellulase isoenzyme patterns of five plant-pathogenic ***Verticillium*** species. Mycol. Res. 92: 297-301.

COUGHLAN M.P. (1988). Stainig techniques for the detection of individual components of cellulolytic enzyme systems. Methods in Enzymology 160: 135-144.

CURRY K.J. & J.W. KIMBROUGH (1983). Septal structures in apothecial tissues of the Pezizaceae (Pezizales, Ascomycetes). Mycologia 75: 781-794.

DENNIS R.W.G. (1978). British Ascomycetes. J. Cramer, Vaduz. Germany.

ERIKSSON K.E. (1978). Enzyme mechanism involved in cellulose hydrolysis by the rot fungus ***Sporotrichum pulverulentum***. Biotech. Bioeng. 20: 317-332.

GAMUNDI I.J. & M.E. RANALLI (1964). Estudio sistemático y biológico de las Ascobolaceas de Argentina I. Nova Hedwigia 7: 517-533.

JACKSON M.A. & D.E. TALBURT (1988). Mechanism for ß-glucosidase release into cellulose-grown ***Trichoderma reesei*** culture supernatant. Exp. Mycol. 12: 203-216.

KIMBROUGH J.W. (1994). Septal ultrastructure and Ascomycete systematics. In: Ascomycete Systematics: Problems and Perspectives in the Nineties (Hawksworth D.L. ed.) p. 127-141. Plenum Press, New York and London.

KIMBROUGH J.W. & K.J. CURRY (1985). Septal ultrastructure in the Ascobolaceae (Pezizales, Ascomycetes). Mycologia 77: 219-229.

KIMBROUGH J.W. & R.P. KORF (1967). A synopsis of the genera and species of the tribe Theleboleae (=Pseudoascoboleae). Amer. J. Bot. 54: 9-23.

KIMBROUGH J.W., R. LUNCH-ALLEN & R.F. CAIN (1969). ***Iodophanus***, the Pezizeae segregate of ***Ascophanus*** (Pezizales). Ann. J. Bot. 56: 1187-1202.

KORF R.P. (1954). A revision of the classification of operculate Discomycetes (Pezizales). Rap. Com. Huitieme Congr. Int. Bot. Paris I Sect. 80: 18-20.

KORF R.P. (1972). Synoptic key to the genera of the Pezizales. Mycologia 64: 937-994.

KORF R.P. (1973). Discomycetes and Tuberales. In: The Fungi. An advanced treatise (G.C. Ainsworth, F.K. Sparrow & A.S. Sussman, eds) 4A: 249-319. Academic Press, New York. USA

MERCURI O..A. (1987). Degradación biológica de celulosa por ***Ascobolus furfuraceus***. Doctoral Thesis, Buenos Aires University. Buenos Aires. Argentina.

MESSNER R., K.HAGSPIEL, C.P. KUBICEK (1990). Isolation of a ß-glucosidase binding and activating polysaccharide fron cell walls of ***Trichoderma reesei***. Arch. Microbiol. 154: 150-155.

MONTGOMERY R.A.P. (1982). The role of polysaccharidase enzymes in the decay of wood by Basisiomycetes. In: Decomposer Basidiomycetes: their biology and ecology, Frankland J.C., J.N. Hedger, M.J. Swift. (eds.), Cambridge University Press, Cambridge. GB. p. 51-56.

NELSON N. (1944). A photometric adaptation of the Somogyi method for the determination of glucose. J. Biochem. 153: 375-380.

PARDO A.G. (1995). Estudio fisiológico sobre la producción del sistema celulolítico de ***Nectria catalinensis*** in vitro. Doctoral Thesis, Buenos Aires University. Buenos Aires. Argentina.

RIFAI M.A. (1968). The Australasian Pezizales in the Herbarium of the Royal Botanic Gardens Kew. Verhandelingen der Koninklijke Nederllandsche Akademie van Wetenschappen, Afdeeling Natuurkunde, Tweede sect. 57: 1-295.

SCHRANTZ J.P. (1970). Etude cytologique en microscopie optique et electronique, de quelques Ascomycetes II. La paroi. Revue de Cytologie et de Biologie Vegetale 33: 111-168.

SOMOGYI M. (1952). Notes on sugar determinations. J. Biol. Chem. 159: 19-23.

TATE R.L. (1995). Soil enzymes as indicators of ecosystem status. In: Soil Microbiology, John Wiley & Sons Inc., New York. USA. p. 123-146.

WELLS K. (1972). Light and electron microscopic studies of ***Ascobolus stercorarius*** II. Ascus and ascospore ontogeny. California University, Publication in Botany 62: 1-93.

MYCOTAXON

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THE MYXOMYCETES FROM BAJA CALIFORNIA (MEXICO). I.

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ABSTRACT - Ten taxa of Myxomycetes from Baja California, México, were studied using light and scanning electron microscopy. *Comatricha anomala, Didymium clavodecum, Physarum brunneolum* and *P. straminipes* represent new records for Mexico. *Badhamia gracilis, B. nitens, Fuligo cinerea, F. intermedia* and *Perichaena luteola* are new records for Baja California. The variety *Badhamia nitens* var. *aurantiaca* is proposed.

RESUMEN - Se han estudiado 10 taxa de Myxomycetes procedentes de Baja California. México. Se aporta un estudio macroscopico y microscopico de los taxa, incluyendo observaciones de las esporas con el microscopio electrónico de barrido. *Comatricha anomala, Didymium clavodecum, Physarum brunneolum* y *P. straminipes* son nuevos registros para México. *Badhamia gracilis, B. nitens, Fuligo cinerea, F. intermedia* y *Perichaena luteola* son nuevas citas para Baja California. Se propone la combinación *Badhamia nitens* var. *aurantiaca*.

KEYS WORDS: Myxomycetes, scanning electron microscopy, taxonomy.

INTRODUCTION

Recently Ogata *et al.* (1994) compiled all existing references up to 1992 about the Myxomycetes from México. In this paper 189 taxa are listed, to which 13 taxa must be added described by Trujillo-Flores (1988), Heredia (1989), Hernández-Cuevas *et al.* (1991), Galindo-Flores *et al.* (1993) and Hernández-Cuevas & Estrada-Torres (1993). In Baja California only three species were published prior to our study, viz. *Perichaena vermicularis* (Schwein.) Rostaf., *Stemonitis axifera* (Bull.) T. Macbride and *S. trechispora* (Berk.) T. Macbride.

The study of Myxomycetes in the southern areas of California has attracted the attention of many researchers in the United States. According to Critchfield & Demaree (1991), 282 myxomycete taxa from California have been found in the arid areas of the Sonora Desert, whose vegetation is comparable to that of the deserts in Baja California (Blackwell & Gilbertson, 1980).

This paper represents our first results concerning the Myxomycetes from Baja California.

MATERIAL AND METHODS

The SEM's were made with a Zeiss DSM-950 microscope. Spore samples were rehydrated with 100% ammonium hydroxide for 30 min, then dehydrated in aqueous ethanol solutions (70%) for 1-1.5 h, before fixation in pure ethylene glycol dimethyl ether (1,2 dimethoxy-methane), after immersion in acetone for at least 2 hours. The spores were subsequently critical point dried, mounted onto an aluminium stub, and coated with gold-palladium in a Polaron E-5000 sputter coater for 120 sec at 1.4 kV and 18 mA (argon atmosphere), creating a metal coating approximately 500 Å thick. Light microscopy (LM) was made with a Nikon Labophot microscope equipped with an automatic photographic system. Samples for these studies were mounted in Hoyer's medium.

The spore wall ornamentation as seen with SEM is described according to the terminology proposed by Rammeloo (1974, 1975).

Specimens are deposited in the Herbarium of the Departamento de Biología Vegetal (Botánica), Universidad de Alcalá de Henares, Spain (AH). Some material is also deposited in the private herbarium of N. E. Nannenga-Bremekamp (The Netherlands) in BR.

SPECIES DESCRIPTIONS

Badhamia gracilis (T. Macbride) T. Macbride *in* T. Macbride & G. W. Martin, *Myxomycetes* 35. 1934. (Figs. 15-17)

Material studied. MEXICO, Baja California: On stem of *Agave shawii* Engelm., Cataviña, 13-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 16039, 16042). On the stem of *Agave shawii* Engelm., Cataviña-Bahía de los Angeles highway (near Cataviña), 14-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 15800, 15804, 15812, 16040, 16044). On dead cladodes of *Opuntia* sp., km 14 of the Ensenada-Tijuana highway (near Tijuana), 4-XII-1994, M. Lizárraga (AH 17071). On stem of *Yucca* sp. and *Agave* sp., km 16 of the Ensenada-Tijuana highway (near Tijuana), 4-XII-1994, M. Lizárraga (AH 17115). On wood of *Quercus agrifolia* Nee. and stem of *Yucca* sp., km 5 of Tecate-Mexicali highway (near Tecate), 31-XII-1994, M. Lizárraga (AH 18453). On stem of *Opuntia* sp. and *Ferocactus* sp., road to Valle las Palmas, Tijuana, 13-XI-1995, M. Lizárraga (AH 18454). USA: On *Yucca* sp., Leyden, Southern Colorado, 25-VI-1910, E. Bethel (BPI 802760 -lectotype-, 802761, 802762, 802763).

Sporangia 0.4-0.7 mm diam., sessile or stipitate, globose or subglobose, clustered; peridium white or grey, thin, fragile, covered with calcareous deposits; dehiscence irregular; stalk if present, pale yellow, thin, short; capillitium delicate, badhamioid, consisting of white tubes with calcareous deposits; spores 12-16 µm diam., globose or subangular, black in mass, dark brown by transmitted light, free, irregularly warted; seen by SEM spore ornamentation baculate.

Remarks. *Badhamia gracilis* is separated from the other species of the genus both by its habitat on rotting succulent plants belonging to Agavaceae and Cactaceae (*Opuntia*, *Yucca*, *Agave*, *Ferocactus*), and the angular shape and the ornamentation of delicate dark pressure ridges and dense minute warts on the spores. Scheetz & Alexopoulos (1971) showed with TEM that the spores of *B. gracilis* do not appear to be homologous with ridges of truly reticulate myxomycete spores.

Recently Castillo *et al.* (1996) studied the type of *Badhamia melanospora* Spegazzini (characterized by having larger spores, 16-18 µm diam.) and proposed this taxon as a variety of *B. gracilis*. Another species close to *B. gracilis* that grows on *Opuntia ficus-indica* is *B. grandispora* Illana & Moreno, which differs, however, by its pink sporangia and minutely papillose spores (Illana *et al.*, 1992).

There is only one previous record of *Badhamia gracilis* from the State of Mexico (Braun & Keller, 1976). However, we believe that it must be a common species on decomposing Cactaceae and other succulent plants in the deserts of Baja California.

Badhamia nitens Berkeley, *Trans. Linn. Soc. London* 21: 153. 1853. (Figs. 7-9)

Material studied. MEXICO, Baja California: On stems of live of *Adenostoma sparsifolium* Torr. (Fam. Papilionaceae), Tecate-Mexicali highway (Cañada Verde), 6-II-1993, M. Lizárraga, G. Moreno & C. Illana, (AH 15805, 15813, 15818, 15922, 15928, 15929, 15937, 15961, 15962, 15963). On wood of *Rhus* sp. (Fam. Coriariaceae), Las Chichihuas, 10-II-1993, G. Moreno, C. Illana & M. Lizárraga (AH 15988). On wood of *Quercus agrifolia* Nee., Tecate-Ensenada highway (Ejido Ignacio-Zaragoza), 6-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 15885, 15887).

Sporangia 0.5-1 mm in diam., sessile, globose, closely crowded or gregarious; peridium fragile, consisting of two appressed layers; the outer layer is yellow and covered with calcareous deposits (disintegrates partially in young specimens and sometimes is completely absent) and the inner persistent layer is hyaline and iridescent; dehiscence irregular; capillitium yellow, consisting of calcareous tubes forming a network; spores 11-13 x 10-11 µm, pyriform, in compact clusters of 4-20 units, black in mass, purple-brown by transmitted light, densely warted on exposed surfaces; with SEM spore ornamentation is smooth at points of contact, but consists of densely aggregate isolated bacula with minutely forked apex in the exposed area of the spore cluster.

Remarks. Collections of *Badhamia nitens* without the yellow outer layer may be mistaken for *B. versicolor* Lister, but the latter species has loose spores, in irregular clusters of 10-40 units.

This is the first record of *Badhamia nitens* for Baja California but, Hernández-Cuevas & Estrada-Torres (1993) reported it earlier from the State of Tlaxcala in México.

Badhamia nitens* var. *aurantiaca (Lizarraga, G. Moreno & Illana) Lizárraga, G. Moreno & Illana, ***comb. et status novo.*** (Figs. 1-6)

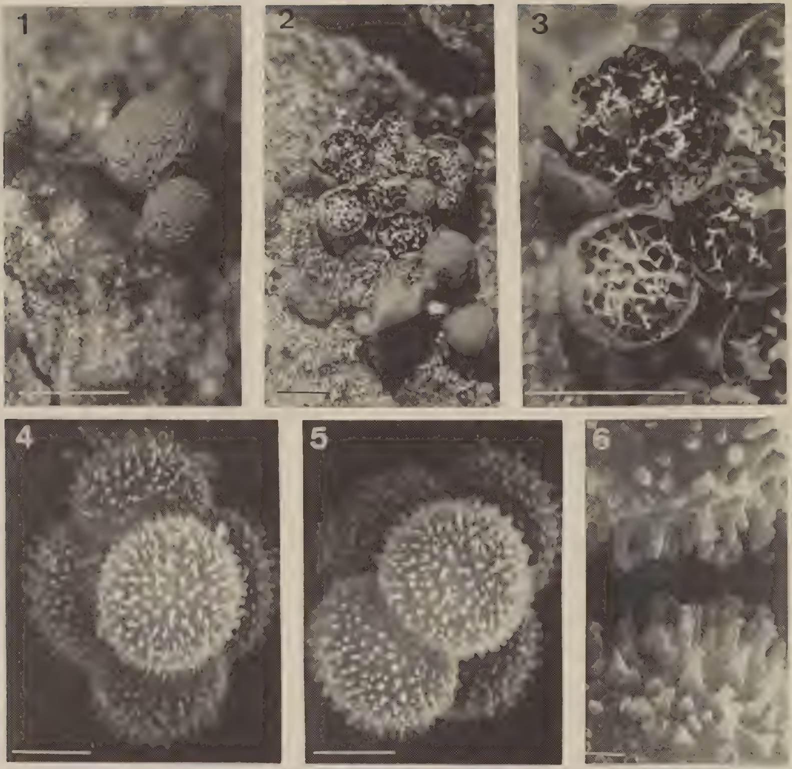
= *B. aurantiaca* Lizarraga, G. Moreno & Illana, *in* Lizárraga, G. Moreno, Illana & Castillo, *Abstr. 2nd. Intern. Congr. Syst. Ecol. Myxomycetes*: 56. 1996.

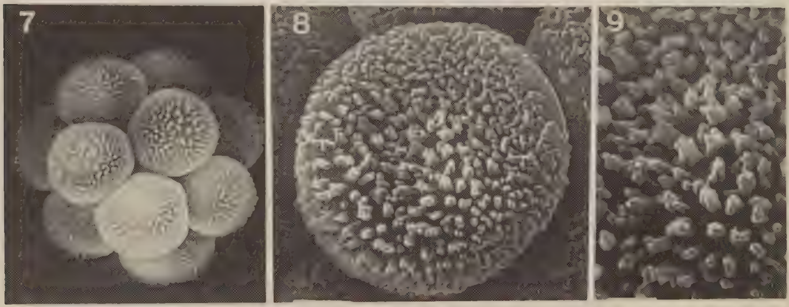
Material studied. MEXICO, Baja California: On leaves of *Rhus laurina* Nutt. (Fam. Coriariaceae), San Antonio de las Minas, Ensenada, 18-I-1995, M. Lizárraga & J. Torres (Holotype, AH 17073). Isotype in the herbarium of Nannenga-Bremekamp nº 17313. SPAIN: On wood of *Quercus ilex* L., Peraleda del Zaucejo, Badajoz, 7-1-1996, J.R. García, AH 16168.

Sporangia 0.3-0.5 mm diam., sessile, globose or subglobose, crowded to gregarious; peridium orange, one-layered, fragile, surface roughened; dehiscence irregular; hypothallus membranous, transparent; columella absent; capillitium pale yellow or white, dense, consisting of irregular, calcareous tubes forming a network; spores 8-10 µm diam., in clusters of 3-6 units, globose or subglobose, black in mass, dark violaceous brown by transmitted light, regularly, densely warted on the outside of a cluster nearly 1 µm long; seen by SEM the spore ornamentation consists of bacula, sometimes with forked apex. Plasmodium unknown.

Remarks. *Badhamia aurantiaca* was described from Baja California and distinguished by the combination of spores in clusters of 3-6 and by sessile sporangia with an orange, one-layered and roughened peridium(Lizárraga & al. 1996). However, we have studied an other collection from Spain with an identical peridium as the mexican collection (orange color and one-layered), but with larger spore clusters (like *B. nitens* var. *nitens*). It is better to consider this character difference variety *aurantium* characterized by the orange, one-layered and roughened peridium. This variation in peridial color is common in Myxomycetes, viz. *Physarum viride* (Bull.) Pers. var. *viride*, *Physarum viride* var *aurantium* (Bull.) Lister and *Physarum viride* var. *incanum* Lister (well illustrated by Neubert *et al.*, 1995).

Other species of *Badhamia* having clustered spores may be mistaken for *B. nitens* var. *aurantiaca*, viz. *B. bispora* Whitney with spores clustered in pairs (Whitney, 1978), or *B. versicolor* Lister with loose clusters of 10-40. In general the morphology of the fructifications of *Badhamia nitens* var. *aurantiaca* resembles that of *B. bispora*, but in the latter species the color of the peridium is pale yellow or green. *Badhamia rugulosa* Brooks & Keller (1975) is another species closely related to *B nitens* var. *aurantiaca*, but differs in its bright orange color and rugulose peridium, the type of capillitium and free spores. Macroscopically, *B. nitens* var. *aurantiaca* is also similiar to *Physarum decipiens* Curtis. The sessile sporangia of the latter





FIGS. 1-6 ***Badhamia nitens*** **var.** ***aurantiaca*** (AH 17073, holotype). 1. Sporangia. 2, 3. Sporangia after dehiscence exposing white, calcareous capillitium.. 4, 5. SEM of spore-clusters and spore ornamentation. 6. Details of spore ornamentation showing the bacula with the forked apex. Scale bars: FIGS. 1-3 = 0.5 mm, FIG. 4, 5 = 5µm, FIGS. 6 = 1 µm.

FIGS. 7-9 ***Badhamia nitens*** **var.** ***nitens*** (AH 15962). 7, 8. SEM of spore clusters and spore ornamentation. 9. Details of spore ornamentation showing the baculae with forked apex. Scale bars: FIG. 7 = 5 µm, FIG. 8 = 2 µm, FIG. 9 = 1 µm.

species have orange peridia that are distinguished, however, by their physaroid capillitium and spores free.

Comatricha anomala Rammeloo, *Bull. Jard. Bot. Natl. Belg.* 46: 237. 1976. (Figs. 10-14)

Material studied. MEXICO, Baja California: On wood of *Quercus agrifolia* Nee., Las Chichihuas, 10-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 18610).

Sporangia, 1-1.5 mm high, brown, stalked, cylindric or ovate, apex rounded, in small clusters; hypothallus membranous, transparent, discoid; stalk short, approximately one-third to one-fourth the total length, dark brown or black, fibrous at the base; columella a continuation of the stipe, reaching the apex; capillitium abundant, arising from all parts of the columella, branches forming an external net with numerous short free ends; spores 9-10.5 µm diam., globose, reddish brown in mass, pale brown by transmitted light, minutely and densely warted, usually with small reticulate areas; with SEM the spore ornamentation of isolated bacula or confluent forming a small reticulum.

Remarks. *Comatricha anomala* differs from other species in *Comatricha* by its unique spore ornamentation. This taxon has been recorded from several localities in Europe and from North America only from California (Kowalski & Demaree, 1987). The present record is the first for Baja California.

Didymium clavodecum Whitney, *Mycologia* 71: 1257. 1979. (Figs. 18-21)

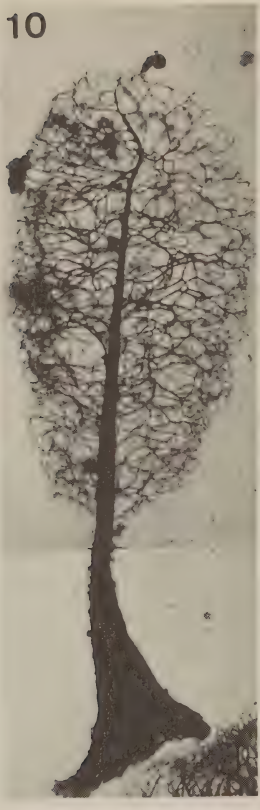
Material studied. MEXICO, Baja California: On leaves and wood of *Quercus agrifolia* Nee., km 65 of the Tecate-Ensenada highway (Ejido Ignacio-Zaragoza), 6-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 15883, 15895, 18627). On leaves of *Quercus agrifolia* Nee., Tecate-Mexicali highway (Cañada Verde), 6-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 15824, 15827, 15828, 15923, 15924, 15926, 15927, 15935, 15943, 15950 18620).

Sporangia or short plasmodiocarps, scattered, sessile, pulvinate, plasmodiocarps annulate up to 4 mm long, sporangia 0.2-1 mm in diam.; stalk short when present, and concolorous with the hypothallus; hypothallus membranous; peridium iridescent, membranous, transparent, encrusted with white, stellate lime crystals; dehiscence irregular; pseudocolumella formed by calcareous deposits in the center of the fructification; capillitium violaceous-brown, rigid, abundant, forming a net joining the columella to the peridium; spores 14-16 µm in diam., globose to subangular, dark in mass, dark violaceous brown by transmitted light, ornamented with piles (nail-like in shape), head larger than 1 µm in diam., covered by a reticulum with 4-6 meshes per hemisphere of thick ridges; spore ornamentation as seen with SEM, long pilae, up to 2.5 µm, irregularly distributed over the spore surface.

Remarks. *Didymium clavodecum* Whitney (1979) was described from California on leaves of *Quercus* sp. The difference between the original description and our observations on the Baja Californian material are in spore size (14-16 µm in our records versus 11-14 µm in the type specimen).

Didymium clavodecum can be readily mistaken for other sessile species in the genus *Didymium*. This refers especially to *D. squamulosum* (Albertini & Schweinitz) Fr., but the two taxa are well separated, in particular by their spore morphology.

Our abundant collections from Baja California come from two different sites. Due to the close geographical distance to the type locality in California (USA), we expect *Didymium clavodecum* to be a common foliicolous species on leaves of *Quercus* sp. This present record of *D. clavodecum* is the first for Mexico and the second in the world.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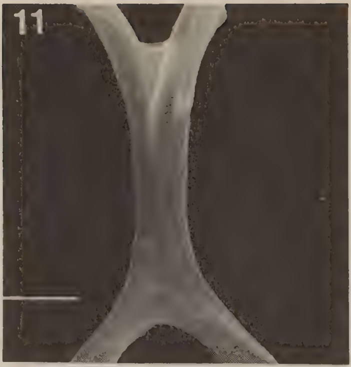
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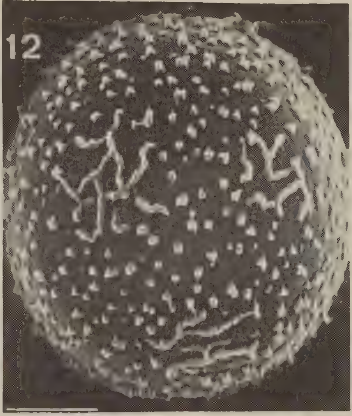
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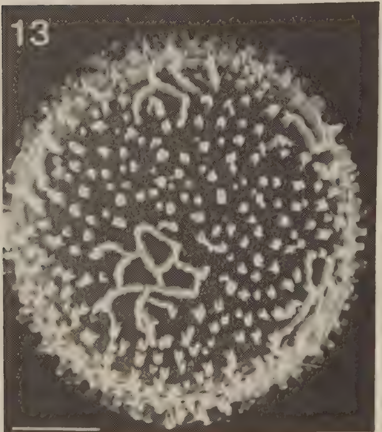
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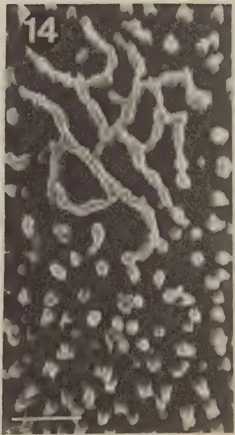
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Fuligo cinerea (Schweinitz) Morgan, *J. Cincinnati Soc. Nat. Hist.* 19: 33. 1896. (Figs. 22-23)

Material studied. MEXICO, Baja California: On stems of dead grasses (Poaceae), Leona Vicario (Tijuana), 23-I-1995, M. Lizárraga (AH 18473, 18483). On stem of dead (Poaceae), near central truck station of Tijuana, 27-XII-1995, M. Lizárraga (AH 17118).

Aethalia, 1-2 cm in diam., pulvinate, in small groups; cortex whitish or pale grey, crustose, impregnated with calcareous granules; capillitium formed by calcareous nodules connected by hyaline threads; spores 12-13 µm in diam., globose to subglobose, black in mass, dark violet-brown by transmitted light, minute warts interconnected by ridges forming a fine reticulum; spore ornamentation as seen with SEM spinose-banded-reticulate, with pillars slightly surpassing the surface of the wall.

Remarks. *Fuligo cinerea* differs from all other members of the genus by its habitat on herbaceous stems (usually found on straw at the entrance of ant nests), and by the dense, minutely reticulate spore ornamentation and somewhat ovoid spores. In Mexico it has been reported from the states of Nuevo León and Sonora (Braun & Keller, 1976; Farr, 1976 and Villarreal, 1990).

Fuligo intermedia T. Macbride, *North American Slime-moulds*, 2nd. ed.: 30. 1922 (Figs. 24-25)

Material studied. MEXICO, Baja California: On leaves of *Larrea tridentata* Engelm. (Fam. Zygophyllaceae)and *Prosopis* sp. (Fam. Mimosaceae), San Felipe, 13-IX-1993, G. Moreno & C. Ochoa (AH 18791). Idem, km 139 of San Felipe-Cataviña highway (Los Cuates), 7-IX-1991, G. Moreno, C. Ochoa, A. Altés & N. Ayala (AH 18792).

Aethalia, 0.5-6 cm diam., in large groups, pulvinate to irregular; cortex thin, sometimes absent; capillitium with hyaline threads connected by calcareous nodules; spores black in mass, pale violet-brown by transmitted light, 11-13 µm in diam., globose, minutely warted, bacculate with as seen SEM.

Remarks. *Fuligo intermedia* is not common in Baja California, and in Mexico it was previously reported only from the state of Nuevo León (Gómez-Sánchez & Castillo, 1981).

Perichaena luteola (Kowalski) Gilert, *Mycol. Res.* 99: 315. 1995. (Figs. 26-29)

≡ *Calonema luteolum* Kowalski, *Madroño* 29: 229. 1969.

Material studied. MEXICO, Baja California: On horse dung, Santa Rosa, 10-II.1993, F. Bersan (AH 16015).

Sporangia 0.3-0.5 mm in diam., sessile, globose or subglobose, heaped; peridium yellow, thin, translucent, smooth; capillitium golden yellow, forming a dense network of threads, 2-4 µm in diam., smooth or irregularly roughened; spores 12-14 µm in diam., spherical, yellow in mass, bright yellow by transmitted light, minutely warted, as seen with SEM bacula regularly distributed over the surface.

Remarks. *Calonema luteolum* has been assigned recently to the genus *Perichaena*. Ultrastructural study has revealed close similarities with species of *Perichaena* in the morphology of the peridium, capillitium and spores (Gilert, 1995). Nannenga-Bremekamp

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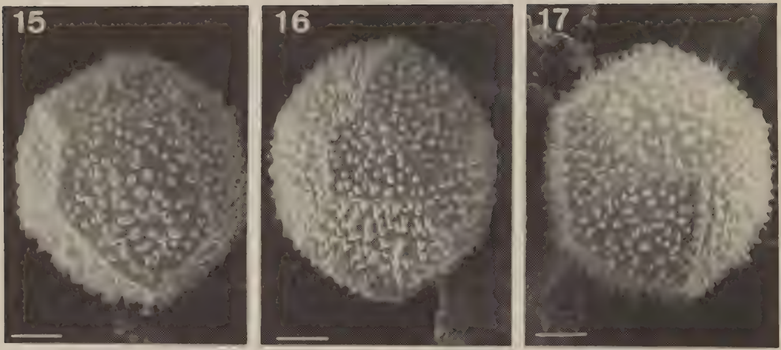
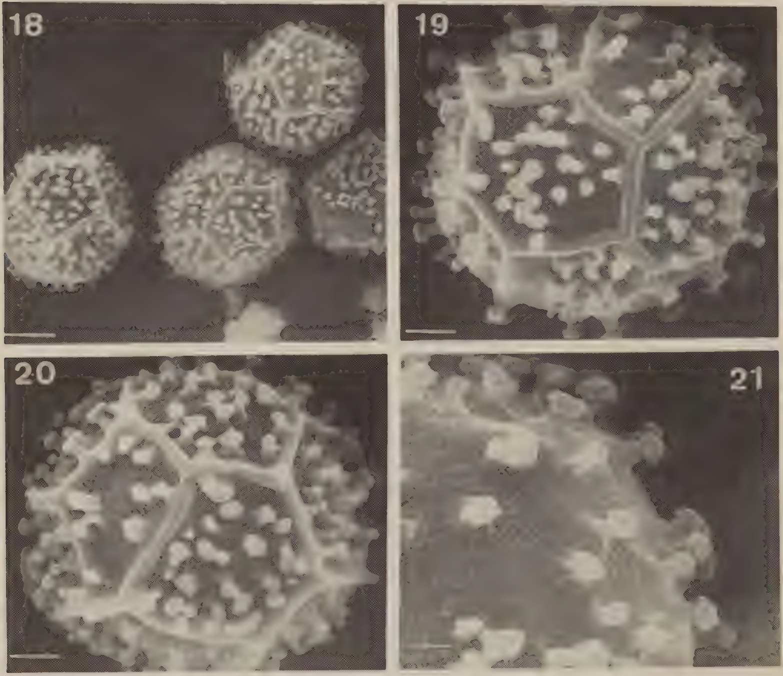
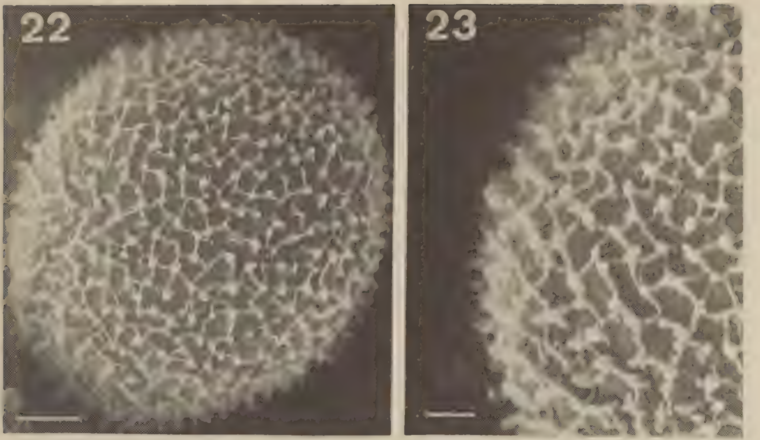
FIGS. 10-14. ***Comatricha anomala*** (AH 18610). 10. Sporangium by transmitted light. 11. SEM of capillitium. 12-13. SEM of spore ornamentation. 14. Details of spore ornamentation showing isolated baculae that also become confluent forming an open reticulate net. Scale bars: FIG. 10 = 0.1 mm, FIG. 11 = 5 µm, FIGS. 12, 13 = 2 µm, FIG. 14 = 1 µm.

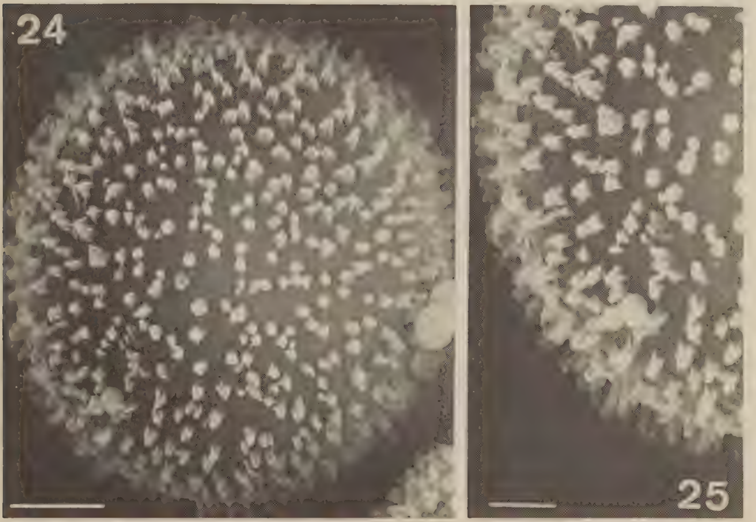




FIGS. -15-17. ***Badhamia gracilis*.** 15-16. SEM of spore ornamentation formed by baculae (AH 17115). 17. SEM of spore ornamentation (lectotype, BPI 802760). Scale bars: FIGS. 15-17 = 2 μm.

FIGS. 18-21. ***Didymium clavodecum*** (AH 15927). 18-20. SEM of spore ornamentation. 21. Details of spore ornamentation showing the long pila and the reticulation. Scale bars: FIG. 18 = 5 μm, FIGS. 19, 20 = 2 μm, FIG. 21 = 1 μm.





FIGS. 22, 23. *Fuligo cinerea* (AH 17118). 22. SEM of spore ornamentation. 23. Details of spore ornamentation showing the simple reticulate type with the pillars slightly surpassing the surface of the muri. Scale bars: FIG. 22 = 2 µm, FIG. 23 = 1 µm.

FIGS. 24, 25. *Fuligo intermedia* (AH 18792). 24. SEM of spore ornamentation. 25. Details of spore ornamentation formed by baculae. Scale bars: FIG. 24 = 2 µm, FIG. 25 = 1 µm.

(1985) suggests, however, that this taxon falls within the generic limits of *Arcyodes* because of its single membranous peridium.

All examined records of *Perichaena luteola* have been found on dung, but Braun & Keller (1976) published one Mexican record (as *Calonema luteolum*) from plant litter. The SEMs included in this paper agree with those of Rammeloo (1983).

Physarum brunneolum (Phillips) Massee, *Monogr. Myxogastr.* 280. 1892. (Figs. 30-31)

Material studied. MEXICO, Baja California: On leaves of *Quercus agrifolia* Nee., San José de la Zorra, 16-III-1990, M. Lizárraga & G. Moreno (AH 17101). On leaves of *Quercus agrifolia* Nee., Ensenada-Santo Tomás highway (Rancho las Jacarandas, Cañón de las Animas), 7-II-1993, C. Illana, G. Moreno, M. Lizárraga (AH 15942). On leaves of *Quercus agrifolia* Nee., Santa Rosa, 10-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 16012, 16013). On thin stems and leaves of *Quercus agrifolia* Nee., San Antonio de las Minas, 14-III-1990, M. Lizárraga & G. Moreno (AH 12636, 12640). Idem, 18-I-1995 (AH 17136). On wood of *Rhus* sp. (Fam. Corariaceae) and *Quercus agrifolia* Nee., Las Chichihuas, 10-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 15992, 15993, 15996, 16004). On leaves of *Rhus* sp., (Fam. Corariaceae) road to Valle Las Palmas (Tijuana), 13-XI-1994, M. Lizárraga (AH 17095).

Sporangia 0.3-1.2 mm in diam., stipitate or sessile, globose, scattered; peridium double, the outer layer yellow-brown, cartilaginous, thick and smooth, the inner layer closely adherent consisting of white calcareous deposits; dehiscence stellate or irregular; stalk short when present, cylindric, stout, dark brown; pseudocolumella sometimes present; capillitium abundant, colorless, formed by calcareous nodules joined by hyaline threads; spores black in mass, violaceous brown by transmitted light, 9-10 µm in diam., globose, warted; with SEM baculate and regularly distributed over the surface.

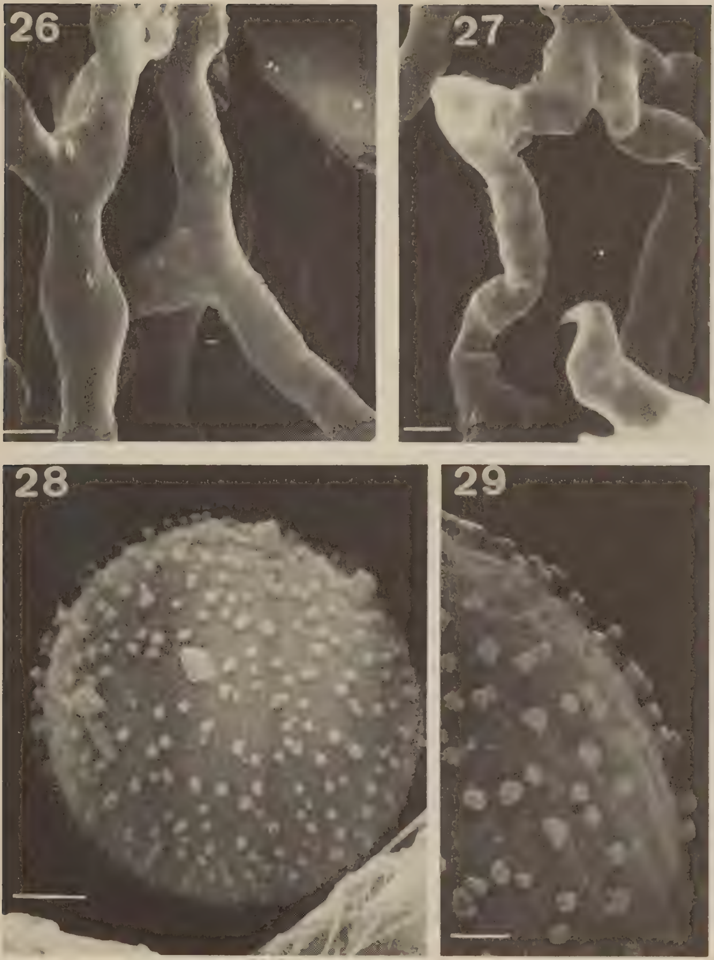
Remarks. *Physarum brunneolum* is a cosmopolitan species growing on leaves of *Quercus* in areas with mediterranean clime. The present record is the first for Mexico.

Physarum straminipes Lister, *J. Bot.* 36: 163. 1898. (Figs. 32-33)

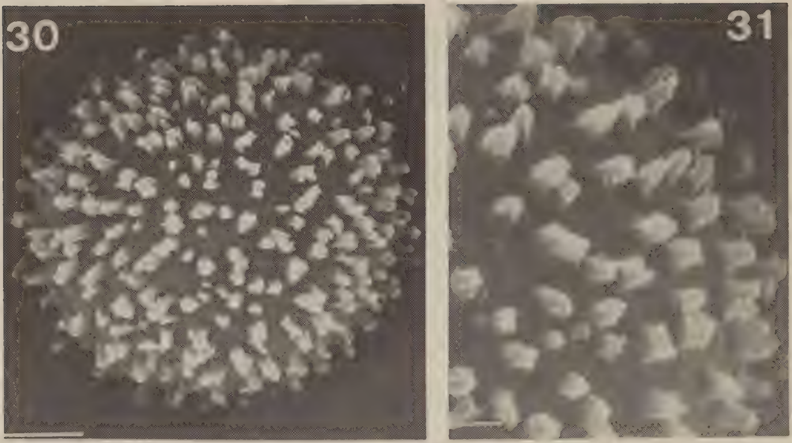
Material studied. MEXICO, Baja California: On a dead stem of *Opuntia basilaris* Engelm. & Bigel, Ensenada-Santo Tomás highway (Rancho las Jacarandas, Cañón de las Animas), 7-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 15817, 15945, 15949, 15956). Same locality, on branches of *Sambucus mexicana* Presl. (AH 18615, 18636, 18637). On dead stem of *Agave shawii* Engelm., La Bufadora, 7-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 18635). Idem, 12-II-1993, M. Lizárraga, G. Moreno & C. Illana (AH 15816, 15969, 16047). On fallen leaves, Facultad de Ciencias, Universidad de Baja California (Ensenada), 21-I-1995, M. Lizárraga (AH 17140, 18452).

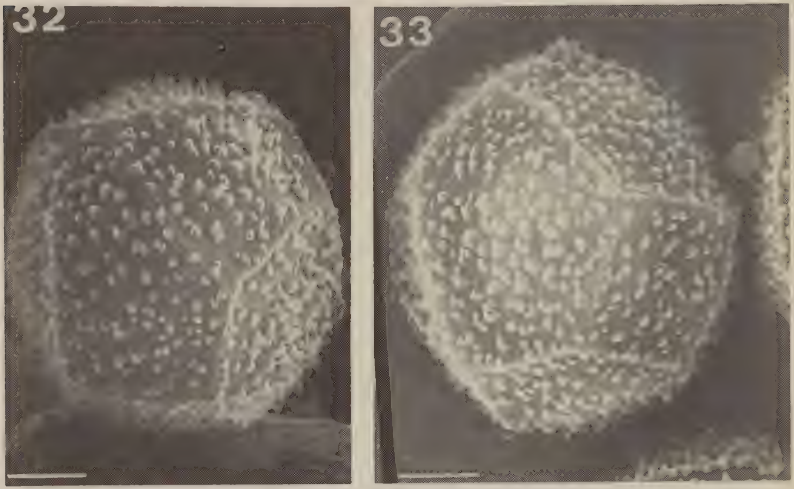
Sporangia 0.5-1 mm diam., sessile or stalked, globose or subglobose, sometimes laterally compressed, crowded, varying to small plasmodiocarps; peridium double, the outer layer grey or whitish with calcareous deposits, the inner hyaline layer membranous; hypothallus pale yellow; stalk short when present, pale yellow; capillitium formed by calcareous nodules joined by hyaline threads; spores black in mass, dark violaceous brown by transmitted light, 12-13 µm diam., globose, distinctly warted within prominently polygonous plates delimited by ridges, with SEM clearly verrucose.

Remarks. *Physarum straminipes* is similar to *Badhamia gracilis* (T. Macbride) T. Macbride in spore morphology (especially with SEM) and in habitat; however, *B. gracilis* differs in its stalked sporangia and capillitium. *Physarum straminipes* prefers rotting debris of succulent plants (López-Sanchez & al., 1986) which are abundant in Mexico. Scheetz & Alexopoulos (1971, 1976) showed with SEM and TEM the similarity betwen the spores of *P. straminipes* and *B. gracilis*. This is the first record for Mexico.



FIGS. 26-29. ***Perichaena luteola*** (AH 16015). 26, 27. SEM of capillitial threads. 28. SEM spore ornamentation. 29. Details of spore ornamentation showing the baculae. Scale bars: FIGS. 26-28 = 2 μm, FIG. 29 = 1 μm.





FIGS. 30, 31. ***Physarum brunneolum*** (AH 17136). 30. SEM of spore ornamentation. 31. Details of spore ornamentation formed by baculae. Scale bars: FIG. 30 = 2 µm, FIG. 31 = 1 µm.

FIGS. 32, 33. ***Physarum straminipes*** (AH 18485). SEM of verrucose spore ornamentation. Scale bars: 2 µm.

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REFERENCES

BLACKWELL M. & GILBERTSON R. L, 1980.- Sonoran Desert Myxomycetes. *Mycotaxon* 11: 139-149.

BRAUN K. L. & KELLER H. W. 1976.- Myxomycetes of Mexico. I. *Mycotaxon* 3: 297-317.

CASTILLO A., ILLANA C. & MORENO G., 1996.- *Badhamia melanospora* Speg. a species wrongly interpreted. *Mycotaxon* 57: 163-170.

CRITCHFIELD R. L. & DEMAREE R. S., 1991.- Annotated checklist of California Myxomycetes. *Madroño* 38: 45-56.

FARR M. L., 1976.- Myxomycetes. *Flora Neotropica* 16. The New York Botanical Garden. New York. 304 pp.

GALINDO-FLORES G., HERNÁNDEZ-CUEVAS L., RODRÍGUEZ-PALMA M. & ESTRADA-TORRES A., 1993.- Contribución al conocimiento de los mixomicetos del Parque Nacional Lagunas de Zempoala. *Acta Bot. Mex.* 21: 27-42.

GILERT E., 1995.- Taxonomic evaluation of the myxomycete *Calonema luteolum*. *Mycol. Res.* 99: 311-316.

GÓMEZ-SÁNCHEZ A. & CASTILLO J., 1981.- Estudio sobre los Myxomycetes del Estado de Nuevo León. *Bol. Soc. Méx. Mic.* 15: 199-224.

HERNÁNDEZ-CUEVAS M., RODRÍGUEZ-PALMA M., GALINDO-FLORES G. & ESTRADA-TORRES A., 1991.- New records of Myxomycetes from Mexico. *Mycotaxon* 42: 17-27.

HÉRNANDEZ-CUEVAS M. & ESTRADA-TORRES A., 1993.- El genero *Badhamia* en el estado de Tlaxcala. *Libro de resumenes del XII Congreso Mexicano de Botánica*, 125 pp.

KELLER H. W. & BROOKS T. E., 1975.- Corticolous Myxomycetes. III: A new species of *Badhamia*. *Mycologia* 67: 1218-1222.

KOWALSKI D. T. & DEMAREE R. S., 1987.- *Comatricha anomala*, a new record for the western hemisphere. *Mycologia* 79: 140-141.

HEREDIA G., 1989.- Estudio de los hongos de la reserva de la Biosfera El Cielo, Tamaulipas. Consideraciones sobre la distribución y ecología de algunas especies. *Acta Bot. Mex.* 7: 1-18.

ILLANA C., MORENO G. & HEYKOOP M., 1992.- Spanish Myxomycetes. V. A new species of *Badhamia* and a new variety of *Physarum*. *Mycotaxon* 45: 241-247.

LIZÁRRAGA M., MORENO G., ILLANA C. & CASTILLO C. 1996.- Two new species of Myxomycetes from Mexico. *Abstr. 2nd. Intern. Congr. Syst. Ecol. Myxomycetes*: 56.

LÓPEZ-SÁNCHEZ E., HONRUBIA M., GRÀCIA E. & GEA F. J., 1986.- Estudio de los Mixomicetos que fructifican sobre *Opuntia ficus-indica* L. en el S.E. de España Peninsular. *Anales Biol., Fac. Biol., Univ. Murcia* 10: 41-48.

NANNENGA-BREMEKAMP N. E., 1985.- Notes on Myxomycetes XXII. Three new species, two new families and four new combinations. *Proc. Kon. Ned. Akad. Wetensch. C.* 88: 121-128.

NEUBERT H., NOWOTNY W., BAUMANN K. & MARX H., 1996.- Die Myxomyceten. Band 2. Physarales. Karlheinz Baumann Verlag. Gomaringen. 368 pp.

OGATA N., NESTEL D., RICO-GRAY V. & GUZMÁN G., 1994.- Los Myxomycetes citados de México. *Act. Bot. Mex.*. 27: 39-51.

RAMMELOO J., 1974.- Structure of the epispore in Trichiaceae (Trichiales, Myxomycetes), as seen with the scanning electron microscope. *Bull. Soc. Roy. Bot. Belgique* 107: 353-359.

RAMMELOO J., 1975.- Structure of the epispore in the Stemonitales (Myxomycetes) as seen with the scanning electron microscope. *Bull. Jard. Bot. Belg.* 45: 301-306.

RAMMELOO J., 1983.- *Calonema luteolum* Kowalski. *Icon. Mycol.* 19-34. Jardin Botanique National de Belgique.

SCHEETZ R. W. & ALEXOPOULOS C. J., 1971.- The spores of *Badhamia gracilis* (Myxomycetes). *Trans. Amer. Microscop. Soc.* 90: 473-475.

SCHEETZ R. W. & ALEXOPOULOS C. J., 1976.- Studies on the spores of Myxomycetes. II. *Physarum straminipes*. *Mycotaxon* 4: 335-339.

TRUJILLO-FLORES F., 1988.- Contribución al conocimiento de los Myxomycetes de la Sierra de Manantlán, Jalisco. *Tiempos de Ciencia* 12: 20-27.

VILLAREAL L., 1990.- Estudios sobre los Myxomycetes de México, I. Nuevos registros. *Micol. Neotrop. Apl.* 3: 67-69

WHITNEY K. D., 1978.- A new species of *Badhamia* with unique spore clusters. *Mycologia* 70: 672-675.

WHITNEY K. D., 1979.- A new foliicolous *Didymium* from Northern California. *Mycologia* 71: 1256-1261.

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CONTRIBUTION TO THE KNOWLEDGE OF FUNGI OF THE GENUS *SPHAEROTHECA* IN YUGOSLAVIA

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A search for powdery mildew agents present in Yugoslavia was carried out during the period 1986-1995. A total of eleven fungal species of the genus *Sphaerotheca* Lév. was observed, viz. *S. aphanis* (Wallr.) U. Braun, *S. dipsacearum* (Tul. & Tul.) Junell, *S. epilobii* (Wallr.) Sacc., *S. euphorbiae* (Cast.) Salmon, *S. ferruginea* (Schltdl.:Fr.) Junell, *S. fugax* Penz. & Sacc., *S. fusca* (Fr.) Blumer, *S. macularis* (Wallr.:Fr.) Lind, *S. mors-uvae* (Schw.) Berk. & Curt., *S. pannosa* (Wallr.:Fr.) Lév., and *S. plantaginis* (Cast.) Junell. They were studied as causal agents of powdery mildew infections on 43 plant species. Six of the identified fungal species are new for Yugoslavia, and 33 new host plant species are recorded. Taxonomic characteristics of these fungi are described and the registered localities as well as the frequency of occurrence are presented. For the determination of the collected material, the taxonomic system given by Blumer (1967), Junell (1967), and Braun (1987) have been used. Material of the collections examined has been deposited in the Mycological Herbarium of the Institute of Biology, Kragujevac (MHIB).

Sphaerotheca aphanis **(Wallr.) U. Braun, Mycotaxon 15, p.136 (1982)**

S. aphanis was found on *Agrimonia eupatoria* L. in Kragujevac, July–October 1990, 1991 and 1992 (rare), MHIB No. 950; on *Geum urbanum* L. in the vicinity of Belgrade, September 1992 (rare), MHIB No. 1316; on *Potentilla erecta* (L.) Hampe in Kragujevac and Niš, September 1994 (rare), MHIB No. 1711; on *Rubus canescens* L. in the district of Koceljeva, August- October 1993 and 1994 (rare), MHIB No. 1634; on *Rubus fruticosus* L and *Rubus idaeus* L. near Valjevo, September 1990 and 1993 (rare), MHIB No. 1318 and 1327.

Mycelium on leaves and stems. Conidial state mostly well-developed, conidia ellipsoid to ovoid, in chains, 25–40 x 16–24 μm. Cleistothecia scattered or densely grouped, 75–101 μm in diameter. Appendages hyaline to yellow, mycelium-like, 2–6 times as long as the diameter of the cleistothecium. Ascus ellipsoid to globoid, 60–95 x 51–75 μm. Ascospores 8, rarely 6 in each ascus, 18–26 x 12–16 μm.

The fungus and the hosts are new for Yugoslavia.

Sphaerotheca dipsacearum **(Tul. & Tul.) Junell, Sv. bot. Tidskr. 62 (1), p. 227 (1967)**

S. dipsacearum was found on *Dipsacus silvestris* Huds. in the Kragujevac area in September 1989 and 1993 (rare); Užice, August 1992 (rare) and Kraljevo, September

1994 (rare), MHIB No. 1011; on *Knautia arvensis* L. near Kragujevac, September 1993 (rare), MHIB No. 1217. Mycelium on leaves, often also on stems and fruits. Conidia cylindrical to ellipsoid, 25–40 x 15–24 µm. Cleistothecia scattered to gregarious, 80–110 µm in diameter. Appendages usually numerous, mycelium-like, septate, yellow-brown, 1–4 times as long as the diameter of the cleistothecium. Ascus sessile, seldom very short-stalked, 55–90 x 50–70 µm. Ascospores (6-) 8 in each ascus, ellipsoid to ovoid, 18–30 x 12–18 µm.

S. dipsacearum is here recorded for the first time from Yugoslavia.

***Sphaerotheca epilobii* (Wallr.) Sacc., Syll. Fung. 1, p. 4 (1882)**

S. epilobii was identified on *Epilobium hirsutum* L. in the vicinity of Kragujevac, September 1994 (rare), near Mladenovac, Belgrade, September 1992 and 1993; and from Šabac and Valjevo 1993 (rare) MHIB No. 1311; on *E. parviflorum* Schreb., and *E. roseum* Schreb., in the district of Smederevo, September 1992 (rare), MHIB No. 1072. Mycelium on leaves and stems. Conidial state well-developed, conidia in chains, ellipsoid-ovoid to doliiform, 25–36 x 15–20 µm. Cleistothecia scattered or densely grouped, 70–101 µm in diameter. Appendages brown, mycelium-like, septate, 1–5 times as long as the diameter of the cleistothecium. Ascus broadly ellipsoid to globoid, 58–87 x 48–61 µm. Ascospores (6–) 8, rarely 6 in each ascus, ellipsoid-ovoid, 16–27 x 12–17 µm.

Ranojević (1910) reported *S. epibolii* on *E. hirsutum* and *E. roseum* from the territory of the present Yugoslavia.

***Sphaerotheca euphorbiae* (Cast.) Salmon, Bull. Torrey bot. Club 29, p. 95 (1902)**

S. euphorbiae was found on *Euphorbia amygdaloides* L. in the vicinity of Valjevo, September 1990 and Kragujevac, September 1992 (rare), MHIB No. 1317; on *Euphorbia cyparissias* L. in the district Valjevo, Koceljeva, September 1989 and 1990 (rare), MHIB No. 1111; on *Euphorbia virgata* Waldst. et Kit. near Kragujevac, July-October 1986 - 1994 (common), MHIB No. 893. Mycelium on leaves and stems. Conidia cylindrical to ellipsoid, 26–34 x 12–16 µm. Cleistothecia surrounded by a dense felt of persistent mycelium, consisting of brown, coarse, undulate hyphae, 80–108 µm in diameter. Appendages narrow, hyaline or faintly coloured, septate, 1–2 times as long as the diameter of cleistothecium. Ascus ellipsoid, 77–102 x 50–70 µm. Ascospores 8 in each ascus, ellipsoid-ovoid, 20–28 x 12–18 µm.

Powdery mildews on these species, as well as the agent *S. euphorbiae*, are here recorded for the first time from Yugoslavia.

***Sphaerotheca ferruginea* (Schltdl.:Fr.) Junell, Trans. Brit. mycol. Soc. 48, p.547 (1965)**

S. ferruginea was found on *Sanguisorba minor* Scop. in Kragujevac, October 1994 (rare), MHIB No. 1506. Mycelium on pedicels, leaves and stems. Conidial state well-developed, conidia in chains, 24–30 x 12–18 µm. Cleistothecia scattered or gregarious, 80–102 µm in diameter. Appendages numerous, coarse, dark brown, 1–6 times as long as the diameter of the cleistothecium. Ascus broadly ellipsoid, 52–80 x 45–70 μm. Ascospores 8, rarely 6 in each ascus, 18–27 x 12–18 μm.

The fungus and the host are new records for Yugoslavia.

Sphaerotheca fugax **Penz. & Sacc., Atti Ist. Ven. Sci. 6 (2), p.586 (1884)**

S. fugax was found on *Geranium pusillum* Burm.. in Leskovac, September 1995 (rare), MHIB No. 1810. Mycelium on leaves and stems. Conidial state well-developed, conidia in chains, 20–33 x 15–25 μm.Cleistothecia scattered on leaves, and densely aggregated at stems, 70–105 μm in diameter. Appendages straight, more or less brown and 1–5 times as long as the diameter of the cleistothecium.

The fungus and the hosts are new records for Yugoslavia.

Sphaerotheca fusca **(Fr.) Blumer, Beitr. Krypt.–Fl. Schweiz 7 (1), p. 117 (1933), emend. U. Braun (1985, p.167)**

S. fusca was identified on *Bidens tripartitus* L. and *Erigeron canadensis* L. in numerous localities of Yugoslavia (Belgrade, Kragujevac, Užice, Čačak, Valjevo, etc.), July–October 1990–1995, (common), MHIB No. 949 and 972; on *Cucumis sativus* L., *Cucurbita maxima* Duch., *Cucurbita pepo* L. throughout the investigated region (Kragujevac, Topola, Knić, Kraljevo, Valjevo, Šabac etc.), July–October 1990-1995 (common), MHIB No. 893, 894 and 897; on *Helianthus tuberosus, Lapsana communis* L. and *Melampyrum arvense* L. in Kragujevac and Valjevo, September 1991 (rare), MHIB No. 1792, 1797 and 1798; on *Melampyrum pratense* L. in the district Kragujevac, August 1990 (rare), MHIB No. 893; on *Odontites rubra* Gilib. near Koceljeva, October 1991 (rare), MHIB No. 1063; on *Physalis alkekengi* L. in the vicinity of Kragujevac, Čačak, Jagodina and Užice, September 1991 and 1992 (rare), MHIB No. 1037; on *Taraxacum officinale* Web., *Xanthium spinosum* L. and *X. strumarium* L. in the vicinity of Kragujevac, Gornji Milanovac, Valjevo and Čačak, August-October 1990-1995 (common), MHIB No. 804; 973 and 974; on *X. italicum* Morett. in Čačak, September 1990 (rare), MHIB No. 966; on *Zinnia elegans* Jacq. troughout the investigated region during July-October 1990-1995 (common), MHIB No. 998.

Mycelium on leaves and stems. Conidia in chains, ellipsoid to ovoid, about 25–40 x 16–24 μm. Cleistothecia scattered to gregarious, 70–105μm in diameter. Appendages hyaline to yellow–brown, interlaced with each other, a few times irregularly branched and 1–4 times as long as the diameter of the cleistothecia. Ascus ellipspoid–ovoid to subglobose, 50–85 x 42–70 μm. Ascospores 8, rarely 6 or 4, in each ascus, 15–25 x 12–18 μm.

Ranojević (1910) observed powdery mildews on *B. tripartitus, E. canadensis, T. officinale, X. spinosum, X. strumarium*. He reported *Sphaerotheca humuli* (DC.) Schroet. as the causal agent.

C. sativus, C. pepo, C. maxima, L. communis, M. arvense, M. pratense, O. rubra, Ph. alkekengi, X. italicum and *Z. elegans* are new hosts for Yugoslavia.

***Sphaerotheca macularis* (Wallr.:Fr.) Lind, Danish Fungi, p. 160 (1913)**

S. macularis was identified on *Humulus lupulus* L. in the surroundings of Kragujevac, Valjevo, Šabac, Kraljevo, Jagodina and Užice, July–October 1990–1995 (rare), MHIB No. 1027.

Mycelium on leaves and inflorescences. Conidia ovoid to barrel-shaped, formed is long chains, 22–30 x 18–23 μm. Cleistothecia abundant, scattered or grouped, 75–105 μm in diameter. Appendages numerous, yellow to brown, often undulate and 1-6 times as long as the diameter of the cleistothecium. Ascus ellipsoid, 63–78 x 53–64 μm. Ascospores 8, rarely 6 in each ascus, 16–23 x 11–15 μm.

In Yugoslavia, powdery mildew on *H. lupulus*, was reported by Ranojević (1910), and Aćimović et al. (1966).

***Sphaerotheca mors-uvae* (Schw.) Berk. & Curt., Grevillea 4, p. 158 (1876)**

S. mors-uvae was identified on *Ribes nigrum* L. and *R. rubrum* L. in the surroundings of Valjevo and Koceljeva, August 1990, and Čačak, August 1991 (rare), MHIB No. 964, 965; on *R. uva-cripsa* L. in Kragujevac, September 1995 (rare), MHIB No. 2009.

Mycelium on leaves and stems of young shoots. Conidia ellipsoid to cylindrical, 23–30 x 15–21 μm. Cleistothecia usually gregarious, 84–105 μm in diameter. Appendages hyaline to yellow, usually as long as the diameter of the cleistothecium. Ascus ellipsoid to oval, 63–100 x 48–60 μm. Ascospores 8, rarely 6 or 4 in each ascus, 15–27 x 11–15 μm, ellipsoid.

In Yugoslavia, this fungus has been reported on *Ribes nigrum* (Grujičić & Tomašević, 1956; Perišić, 1970). Powdery mildew on *R. rubrum* and *R. uva-cripsa* is here recorded for the first time from this country.

***Sphaerotheca pannosa* (Wallr.: Fr.) Lév. Ann. Sci. Nat., bot., 3 sér., 15, p.138 (1851)**

S. pannosa was identified on *Prunus persica* (L.) Batsch in the vicinity of Kragujevac, Valjevo and Čačak, September 1991 and 1992 (rare), MHIB No. 1277; on *Rosa banksiana* R. Br., *R. canina* L., *R. pendulina* L., *R. polyantha* Hort. and *Rosa* spp., through the investigated region (Kragujevac, Belgrade, Priština, Niš etc.), June-October 1986-1994 (common), MHIB No. 998, 1079, 1173, 124, 1251.

On leaves, sepals, fruits and stems. Conidia ellipsoid-ovoid, 22–31 x 13–18 μm. Cleistothecia immersed in the mycelial layer, 70–99 μm in diameter. Appendages hyaline, mycelium-like, few, very short, rarely some-whart longer than the diameter of the cleistothecium. Ascus broadly ellipsoid, 60–103 x 40–62 μm. Ascospores 8 in each ascus, 12–21 x 9–15 μm.

Grujić and Tomašević (1956), Spasić (1961), Topalović (1964) and Mijušković (1974) recorded powdery mildew on *P. persica* and *Rosa* spp. from Yugoslavia.

***Sphaerotheca plantaginis* (Cast.) Junell, Sv. bot. Tidskr. 60 (3), p.382 (1966)**

S. plantaginis was identified on *Plantago lanceolata* L. and was widely distributed throughout Yugoslavia (Belgrade, Kragujevac, Topola, Jagodina, Valjevo, Šabac, etc.) during June–October 1990–1995 (common), MHIB No. 882; on *Plantago media* L. in Kragujevac, September 1988 (rare), MHIB No. 797.

Mycelium on both surfaces of the leaves. Conidia ellipsoid to ovoid, 30–43 x 16–21 µm. Cleistothecia abundant, scattered or in groups, 70–95 µm in diameter. Appendages hyaline to yellow, seldom branched, usually as long as the diameter of the cleistothecium, sometimes longer. Ascus ellipsoid to globoid, 60–80 x 48–67 µm. Ascospores 8, rarely 6 in each ascus, ellipsoid, 15–28 x 11–18 µm .

S. plantaginis on *P. lanceolata* and *P. media* are reported for the first time from this region.

Literature

Aćimović, M., Arsić, M., and M. Radović (1966): Neki problemi zaštite hmelja u AP Vojvodina. Biljni lekar 8: 72-82.

Blumer, S. (1967): Echte Mehltaupilze (Erysiphaceae). Ein Bestimmungsbuch für die Europa vorkommenden Arten .Jena, VEB Gustav Fischer Verlag, 1-436.

Braun, U. (1987): A monograph of the Erysiphales (powdery mildews). Beih. Nova Hedwigia 89: 1-700.

Grujić, G., and B. Tomašević (1956): Izveštaj o bolestima i štetočinama za period 1934-1953. Zaštita bilja 8: 61-22.

Junell , L. (1967): Erysiphaceae of Sweden . Symb. Bot. Upsal. XIX: (1): 1-117.

Mijušković, M., and Z. Vučinić (1974): Prilog poznavanju parazitne mikroflore Crnogorskog primorja. Glas. republ. Zav. zašt. prirode -Prirodnjačkog muzeja Titograd 7: 5-35.

Perišić, M. (1970): *Sphaeroteca mors-uvae* (Schein.) Berk. et Curt. prouzrokovač pepelnice na crnoj ribizli. Jugosl. voćarst. 11(12): 219-222.

Ranojevic, N. (1910): Zweiter Beitrag zur Pilzflora Serbiens. Annal. mycol. 8: 347–402.

Spasić, M. (1961): Prilog poznavanju parazitne flore na gajenom bilju Timočke Krajine. Zaštita bilja 63: 57-63.

Topalović, G. (1964): Prilog proučavanju biologije i suzbijanja *Sphaerotheca pannosa* (Wallr.) Lév. var *persicae* Woronic. parazita bresaka Doktorska disertacija. Polj. fak., Zemun, 1-147.

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SOME NEW SPECIES AND NEW RECORDS OF DISCOMYCETES IN CHINA. VII*

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ABSTRACT This paper is based mainly on our studies of the Chinese Geoglossaceae and Sarcoscyphaceae together with a few other fungi. Among them, *Geoglossum laccatum*, *Nothomitra sinensis*, *Trichoglossum hirsutum* var. *latisporum*, and *Trichoglossum qingchengense* are described as new. Thirteen taxa belonging to *Geoglossum*, *Kompsoscypha*, *Microstoma*, *Nanoscypha*, *Phillipsia*, *Sowerbyella*, *Torrendiella* and *Trichophaeopsis* are recorded for the first time from China. Name changes for thirteen previously reported taxa are noted. Notes are provided for five accepted Geoglossceous fungi.

NEW TAXA

1. *Geoglossum laccatum* W. Y. Zhuang, **sp. nov**. (Fig. 1)

Ab *Geoglosso glutinoso* ascosporis crassis; paraphysibus filiformibus, circinatis, laccatis differt.

Dried ascocarps 50-57 mm high, stipitate, tissues highly gelatinous; ascogenous portion black, lanceolate to clavate, compressed, 14-15 x 2.5-3 mm; stipes concolorous with hymenium, nearly terete, outer layer obviously gelatinous, 20-30 x 1.5-2.5 mm. Hymenium 240-250 µm thick. Asci clavate, 8-spored, J+ in Melzer's reagent, pore walls strongly blue, 228-254 x 18-20 µm. Ascospores subcylindrical, slightly narrow at the

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lower end, multiseriate, brown, 7-septate, 72-94 x 6-7 µm. Paraphyses filiform, not enlarged at apex, subhyaline, contents refractive or laccate, strongly curved or circinate at apex, remotely septate, 3-4 µm wide at apex and 2.5 µm below.

Holotype: on soil, Qingchengshan, Sichuan, C.-m. Wang, Y.-x. Han, & Q.-m. Ma (663), 13 VIII 1960, HMAS 30745.

Notes: The fungus was found when several specimens under the name *Geoglossum glutinosum* Pers. : Fr. were re-examined. The tissues of HMAS 30745 are highly gelatinous. Compared with the typical *G. gelatinosum* (Mains, 1954), it has wider ascospores (6-7 µm wide vs. 4-6 µm wide), refractive, narrow and filiform paraphyses, and strongly curved to circinate paraphysis apices. A new species is thus proposed.

2. ***Nothomitra sinensis*** W. Y. Zhuang, **sp. nov.** (Fig. 2)

Ab *Nothomitrae* specibus aliis differt ascis 107-150 x 12-16 µm, ascosporis (38-)46-64 x 2.5-3.5 µm, conidiis intra ascos abundis .

Dried ascocarps 33-45 mm high, stipitate; ascogenous portion clavate to capitate, not compressed, surface glabrous, sharply distinguished from the stipe, dark brown, dark reddish brown, to brown, 6-19 x 4-7 mm; stipes subcylindrical, swollen or not swollen at base, light to dark brown, 18-30 x 1.5-2.5 mm, up to 6 mm wide at the swollen base. Hymenium 130-135 µm thick. Asci clavate, 8-spored, J- in Melzer's reagent with or without KOH pretreatment, pore walls not blue, 107-150 x 12-16 µm. Ascospores subcylindrical to acicular, with the lower end slightly narrowed, multiseriate, hyaline, non-septate when young and up to 4-septate at maturity, (38-)46-64 x 2.5-3.5 µm. Paraphyses filiform, slightly enlarged at apex, straight or curved, sometimes branched at upper portion, 2-4 µm wide at apex. Conidia produced abundantly within ascus, budded from ascospores, ascoconidia subspherical, hyaline, 3-4(-5) x 3 µm.

Holotype: on the ground among mosses in the conifer forest, Zhangye, Gansu, alt. 2850 m, Q.-m. Ma (785), 1 IX 1958, HMAS 24108.

Paratypes: on duff, Qilian, Qinghai, alt. 3180 m, Q-m. Ma (338), 29 VII 1958, HMAS 32694; on the ground in forest, North Muzhaerte River, Xinjiang, 2600 m, S.-x. Sun, H.-a. Wen, & X.-l. Mao (441), 21 VII 1978, HMAS 39228.

Notes: The fresh color of the fruitbodies was not recorded by the collectors. All three specimens were misidentified as *Microglossum fumosum* (Peck) E. J. Durand, which might indicate that the fungus has brown tints when fresh. They were all collected from high altitude areas

(2600-3180 m). There are two other known species of the genus in the world (Raitviir, 1971; Hawksworth et al., 1995). *Nothomitra sinensis* W. Y. Zhuang differs mainly from *N. cinnamomea* Maas Geesteranus (1964) in shape and size of ascospores, formation of conidia within asci, and shape of paraphyses and of fruitbodies.

The way of conidial formation and shape of ascospores and of asci recall those in *Cudonia lutea* (Peck) Sacc. and *Spathularia flavida* Pers. : Fr. (Mains, 1955, 1956), entirely different fungi.

3. ***Trichoglossum hirsutum*** var. ***latisporum*** W. Y. Zhuang, **sp. nov**. (Fig. 3)

Var. *hirsuto* simile sed ascosporis latis, 115-157 x 6.5-8.0 µm; apotheciis grandioribus differt.

Dried ascocarps 43-78 mm high, stipitate; ascogenous portion dark brown to blackish brown, spathulate to ellipsoid, compressed, 10-22 x 4-10 mm; stipes concolorous, terete, 30-60 x 1.7-2.5 mm. Setae dark brown to dark reddish brown, thick-walled, 7-15 µm wide, 0-150 µm protruding above the asci. Medullary hyphae pale brown to subhyaline, 3-8 µm wide. Hymenium 280-300 µm thick. Asci clavate, 8-spored, J+ in Melzer's reagent, pore walls blue, 230-260 x 23-25 µm. Ascospores elongate-subfusoid, brown, multiseriate, mostly 15-septate, 115-157 x 6.5-8 µm. Paraphyses filiform, straight or slightly curved, pale brown, 4-7.5 µm at apex and 4-5 µm below.

Holotype: on soil, Diaoluoshan, Hainan, J.-c. Xing (342), 29 XI 1958, HMAS 27762.

Notes: This variety differs from *Trichoglossum hirsutum* (Pers. : Fr.) Boud. var. *hirsutum* (Mains, 1954) in broader ascospores and larger apothecia.

4. ***Trichoglossum qingchengense*** W. Y. Zhuang, **sp. nov.** (Fig. 4)

Ab *Trichoglosso raso* ascosporis brevibus, crassis; pilis perpaucis, angustis differt.

Dried ascocarps 20-26 mm high, stipitate; ascogenous portion nearly black, broadly clavate, compressed, 7-9 x 3-4 mm; stipes dark brown, somewhat compressed, 6-12 x 1.5-1.8 mm. Setae present in hymenium and stipe, very few and easily overlooked, brown, thick-walled, 5-6.5 µm wide. Medullary hyphae pale brown, 3-7.5 µm wide. Hymenium 230-240 µm thick. Asci clavate, mostly 8-spored and some containing fewer than 8 spores, J+ in Melzer's reagent, pore walls strongly blue, 198-230 x 20-24 µm. Ascospores subcylindrical, somewhat narrow at lower end, brown, with (6-)7-9 septa, wider in the asci with fewer than 8 spores, (76-)97-115(-117) x 6.5-7.7 µm. Paraphyses slightly enlarged at apex, straight, curved, or circinate, 5-7.5 µm wide at apex and 3-4 µm wide in the lower portion.

Holotype: on soil, Qingchengshan, Sichuan, C.-m. Wang, Y.-x. Han, & Q.-m. Ma (663a), 13 VIII 1960, HMAS 30746.

Notes: HMAS 30746, lacking of gelatinous tissues in the ascocarps, was mistakenly identified as *Geoglossum glutinosum* Pers. Careful examination revealed that a few brown setae which are easily overlooked were present in the hymenium and on the stipe of the fungus, which proved that the fungus should be placed in the genus *Trichoglossum*. The closest species in that genus is *T. rasum* Pat. (Mains, 1954) from which HMAS 30746 differs in subcylindrical, shorter and broader ascospores, wider asci, and lack of densely distributed setae, which makes the surface of fruitbody somewhat glabrous.

Trichoglossum sinicum F. L. Tai has fewer setae than other species in the genus. But the number of setae present in *T. qingchengense* is even less than that in *T. sinicum*, the number of spore septa is (6-)7-9 instead of 12-15, and the size of ascospores is different, too.

NEW RECORDS FOR CHINA

5. ***Geoglossum alveolatum*** (Rehm) E. J. Durand, Ann. Mycol. 6: 432, 1908.

Diagnostic features: Dried ascocarps irregularly capitate, compressed or not, stipitate; stipe surface squamulose, with short, brown hyphal extensions in fascicles. Ascospores subcylindrical, slightly narrower at the lower end, hyaline to faintly brownish, with 15 septa, 105-120 x 4-5 µm. Paraphyses straight or curved at the apex, 4-5 µm at the apex and 2-3 µm below.

Specimen examined: on rotten wood, Huangshan, Anhui, students of Fudan University (339), VII 1956, HMAS 49898.

6. ***Geoglossum pumilum*** G. Winter, Grevillea 15: 91, 1887.

Diagnostic features: Dried ascocarps 8-12 mm high, stipitate; ascogenous portion black, spathulate, subcapitate to shortly clavate, 2-3.5 x 1 mm; stipe surface squamulose, 6-10 x 0.3 mm. Asci 8-spored, 160-194 x 18-23 µm. Ascospores cylindrical-clavate, narrow at the lower end, brown, mostly with 15 septa, a few with 12-14 septa, 79-132 x 5-7 µm. Paraphyses slightly enlarged at the apex, mostly straight, light brown.

Specimens examined: on the ground in the forest, Dali, Yunnan, H.-s. Yao, 24 VIII 1938, HMAS 3443; on the ground, Kunming, Yunnan, S.-j. Shen, 2 IX 1943, HMAS 4246.

Notes: Re-examination of the two specimens filed under *Geoglossum subpumilum* Imai in HMAS (Tai, 1944) revealed that they agree well with the concept of *Geoglossum pumilum* G. Winter. The morphology of the Chinese fungus is very similar to the Indian material described by Maas Geesteranus (1965). The ascospores are slightly wider than the Indian ones and mostly with 15 septa.

7. ***Geoglossum simile*** Peck, Buff. Soc. Nat. Sci. 1: 70, 1873.

Diagnostic features: Dried ascocarps 8-11 mm high, stipitate; ascogenous portion broadly clavate, blackish brown to black, 3 x 1.6-1.7 mm; stipes terete, surface squamulose, 3-6 x 1 mm. Asci 4-8-spored, mostly 4-spored, J- in Melzer's reagent, 135-165 x 17-22 µm. Ascospores clavate, slightly narrower at the lower end, 7-septate, 58-100 x 5-7 µm. Paraphyses filiform, slightly enlarged at the apex, straight or curved, some of them constricted at septa and forming oblong to ellipsoid 2-celled segments.

Specimen examined: on soil, Heibaishui, Lijiang, Yunnan, R. P. Korf, L.-s. Wang, W.-y. Zhuang (377), 3 XI 1988, HMAS 70305.

Notes: This species is characterized by the oblong 2-celled segments in the paraphyses. The ascospores of the Chinese material are wider than that of the Indian material [58-100 x 5-7 µm vs. 63-87(-97) x (3.5-)4-6 µm] (Maas Geesteranus, 1965).

8. ***Geoglossum umbratile*** var. ***heterosporum*** (Mains) Maas Greet., Persoonia 4: 37, 1965.

Diagnostic features: Ascocarps club-shaped to subcylindrical, black-brown when fresh, capitate when dry; stipe surface with short hyphal extensions. Asci clavate, 4-spored, J- in Melzer's reagent, 122-150 x 15-21 µm. Ascospores cylindrical-clavate, narrow in the lower portion, mostly with 7 septa, some with 3-6 septa, 56-84 x 5-7 µm. Paraphyses curved to coiled at apex, apical cell enlarged and deformed, light brown, 5-10 µm wide at the apex and 3-5 µm below.

Specimen examined: on soil, Heibaishui, Lijiang, Yunnan, R.P. Korf, L.-s. Wang & W.-y. Zhuang (376), 3 XI 1988, HMAS 70306.

Notes: The Chinese material of this species agrees well with the Indian ones (Maas Geesteranus, 1965).

9. ***Kompsoscypha waterstonii*** (Seaver) Pfister, Mem. N. Y. Bot. Gard. 49: 343, 1989.

Diagnostic features: Apothecia solitary to gregarious, discoid, convex, sessile to subsessile, 2.0-6.5 mm in diam. Hairs present on receptacle surface, especially at the base. Ectal excipulum of textura angularis, (30-)40-100 µm thick. Medullary excipulum up to 400 µm thick. Asci cylindrical-clavate, 8-spored, occasionally 4-spored, 250-300 x 13.5-18.5 µm. Ascospores broadly ellipsoid, symmetrical, smooth-walled, uni-, bi-, or multi-guttulate (guttules indistinct), 17-25.5 x 9.5-14(-16) µm.

Specimens examined: on decaying leaves of *Cupressus* sp., Qingchengshan, Sichuan, R.-y. Zheng & R. P. Korf , 18 IX 1981, HMAS 45910, CUP-CH 2349; on rotten twigs, Summer Palace, Beijing, J.-x. Tian & W.-y. Zhuang (149) 19 VIII 1988, HMAS 57604; on twigs of *Platycladus orientalis*, Yuanmingyuan, Beijing, W.-y. Zhuang & Z. Wang (1185, 1187, 1188, 1189, 1190), 8 VIII 1995, HMAS 70118, 70120, 70121, 70122, 70123; on living roots of *Acorus ceclamus*, Yuanmingyuan, Beijing, W.-y. Zhuang & Z. Wang (1186), 8 VIII 1995, HMAS 70119; on wood, Hudiequan, Dali County, Yunnan, R. P. Korf, M. Zang and W.-y. Zhuang (402), 5 XI 1988, HMAS 70124.

Notes: The genus *Kompsoscypha* Pfister (1989) was erected to accommodate species similar to *Nanoscypha* Denison but possessing symmetrical and eguttulate or indistinctly guttulate ascospores and 8-spored asci. Among the collections examined, HMAS 70119 was on living roots of *Acorus ceclamus* and most collections were on twigs of *Platycladus orientalis*, which have not been reported as substrates. HMAS 45910 has paraphyses up to 6 um wide at apex.

10. ***Microstoma floccosum*** (Schwein.) Raitv. var. ***macrosporum*** Y. Otani, Trans. Mycol. Soc. Japan 21: 158, 1980.

Diagnostic features: Apothecia solitary, deeply cupulate, stipitate. Hairs arising from ectal excipulum, hyaline, acute at the tip, evenly distributed on surface of receptacle and stalk. Ectal excipulum of textura angularis, tissues gelatinous. Ascospores long-ellipsoid, multiguttulate, 50-56 x 19-24 µm.

Specimen examined: on wood, Dailing, Heilongjiang, C.-b. Chen, 27 V 1956, HMAS 24110.

Notes: The fungus differs from *Microstoma floccosum* (Schwein.) Raitv. var. *floccosum* in the large ascospores (Otani, 1980).

11. ***Microstoma aggregatum*** Y. Otani, Rept. Tottori Mycol. Inst. 28: 251, 1990.

Diagnostic features: Apothecia deeply cupulate, stipitate, aggregate, with more than 40 fruitbodies growing together in a fascicle, honeycomb-like. Hairs arising from gelatinous ectal excipulum, obtuse at the tip. Asci 310-330 x 13-17 µm. Ascospores long-ellipsoid, with a large central guttule, 22-27 x 8-11.5 µm.

Specimens examined: on wood, Jiaohe, Jilin, W.-y. Zhuang (738), 27 VIII 1991, HMAS 61307; on wood, Jiaohe, Jilin, X.-q. Zhang & W.-y. Zhuang (737), 27 VIII 1991, HMAS 61308; on wood, Jiaohe, Jilin, W.-y. Zhuang (758), 28 VIII 1991, HMAS 61309; on wood, Jiaohe, Jilin, W.-y. Zhuang & Z.-m. Sun (812), 1 IX 1991, HMAS 61310; on wood, Jiaohe, Jilin, W.-y. Zhuang (795), 31 VIII 1991, HMAS 61311.

Notes: This species differs from *Microstoma protractum* (Fr.) Bernstein in the smaller ascospores (22-27 x 8-11.5 µm vs. 24-45 x 10-14 µm), small and strongly aggregated apothecia and pinkish-lilac hymenium.

12. ***Nanoscypha macrospora*** Denison, Mycologia 64: 621, 1972.

Diagnostic features: Apothecia discoid, sessile, 3 mm in diam. Hymenium orange-red when fresh. Ectal excipulum of textura angularis, 50-70 µm thick. Medullary excipulum ca 70 µm thick. Asci 4(?)-spored. Ascospores ovoid to ellipsoid, smooth-walled, biguttulate or uniguttulate, 23-32 x 12.5-19 µm.

Specimen examined: on rotten twigs of *Cupressus* sp., Chengdu, Sichuan, W.-y. Zhuang (91), 2 VII 1983, HMAS 44070.

Notes: This species is characterized by its large and symmetrical ascospores. It agrees completely with the original description (Denison, 1972).

13. ***Phillipsia crispata*** (Berk. & M. A. Curtis) Le Gal, Prodr. Fl. Mycol. Madagascar 4: 263, 1953. (basionym cited p. 268)

Diagnostic features: Apothecia discoid to ear-shaped, corky, sessile to subsessile, stipes centric to eccentric. Ectal excipulum of textura porrecta, with hyphae somewhat parallel to receptacle surface. Ascospores bean-shaped, with 7-9 fine striations, biguttulate or 3-guttulate, 22-27 x 10-12 µm.

Specimens examined: on the ground, Longlin, Guangxi, L.-w. Xu (1517), 26 X 1957, HMAS 23952; on rotten wood, Ceheng, Guizhou, Q.-z. Wang (321), 7 IX 1958, HMAS 27731; on rotten wood, Longlin, Guangxi, L.-w. Xu (789), 5 XI 1957, HMAS 27732; on rotten wood, Longlin, Guangxi, L.-w. Xu (386), 24 X 1957, HMAS 27733; on the ground in woods, Longlin, Guangxi, L.-w. Xu (39), 19 X 1957, HMAS 27850; on fallen wood in forest, Dongjiu, Xizang, M. Zang (766), 11 IX 1976, HKAS 5766, HMAS 70321.

Notes: Specimens examined for this study were all filed under either *Phillipsia domingensis* Berk. or *Phillipsia subpurpurea* Berk. & Broome. This species is easily confused with *P. domingensis* and *P. subpurpurea* in apothecial gross morphology but differs significantly from them in the fine striations on the ascospore surface.

14. ***Phillipsia carnicolor*** Le Gal, Prodr. Fl. Mycol. Madagascar 4: 281, 1953.

Diagnostic features: Apothecia discoid to deeply cupulate, corky, sessile to subsessile, centric to eccentric. Ectal excipulum of textura porrecta, hyphae somewhat parallel to receptacle surface and some hyphae tangled. Ascospores asymmetrical, ellipsoid, with one side flattened, with 5-9 fine striations, biguttulate, 16.5-20 x 8.5-11.5 µm.

Specimens examined: on rotten wood, Qiongzhong, Hainan, J.-h. Yu (2127), 15 IX 1990, HMAS 28976; on wood, 51 km mark from Mengyang to Xishuangbanna Botanical Garden, R. P. Korf, M. Zang and W.-y. Zhuang (253, 254), 23 X 1988, HMAS 70083, 70084; on rotten wood, Menglun County, Yunnan, M. Zang, 31 VIII 1974, HKAS 1016, HMAS 70312.

Notes: Rifai (1968) treated *Phillipsia carnicolor* Le Gal as a possible synonym of *P. hartmannii* (Phill.) Rifai. He thought that the latter lacks striations on spore surface was a younger stage of the former. The Chinese fungus fits Le Gal's (1953) description well showing ascospore striations clearly. Le Gal's name is thus accepted.

15. ***Sowerbyella fagicola*** Moravec, Ceska Mykol. 27(2): 66, 1973.

Diagnostic features: Apothecia discoid, stipitate, hymenium orange yellow. Ectal excipulum of textura angularis, 50-63 µm thick; cells thin-walled, hyaline, 7.5-25 µm in diam. Medullary excipulum 135-380 µm thick. Asci 160-179 x 7.5 µm. Ascospores subfusoid to fusiform-ellipsoid, uniguttulate to biguttulate, with fine markings on surface, 12-15.5 x 4.8-7 µm; spore markings point at the apex, 0.2-0.4 µm in diam and 0.3-0.4 µm high. Paraphyses slightly enlarged and 3-4.5 µm wide at upper portion.

Specimens examined: on duff, Baihuashan, Beijing, W.-y. Zhuang & Z. Wang (1197, 1254, 1256, 1267), 20 IX 1995, HMAS 70323, 70324, 70325, 70326.

Notes: The Chinese material fits well the morphology of *Sowerbyella fagicola* Moravec. Our SEM study of the ascospore surface morphology is identical with that of the typical material (Moravec, 1973, 1985).

16. ***Torrendiella eucalypti*** (Berk.) Spooner, Bibl. Mycol. 116: 322, 1987.

Diagnostic features: Apothecia discoid, stipitate, up to 1.6 mm in diam. Hymenium dirty-yellow to yellow. Stipe dark brown. Ectal excipulum of textura oblita, cells highly gelatinous. Medullary excipulum of textura intricata, non-gelatinous. Subhymenium indistinguishable. Asci cylindrical-clavate, pore walls blue in Melzer's reagent after 10% KOH pretreatment, 70-97 x 7.5-8.8 µm. Ascospores subfusoid, with 3-5 guttules, biseriate, 16.8-22.0 x 3.7-4.4 µm.

Specimens examined: on leaf blade, Qingchengshan, Sichuan, R.-y. Zheng & R. P. Korf, 16 IX 1981, HMAS 51868, CUP-CH 2330; on leaf blade, Qingchengshan, Sichuan, R.-y. Zheng & R. P. Korf, 18 IX 1981, HMAS 51869, CUP-CH 2400.

Notes: This is the first time that the species is reported in Asia. The Chinese material has slightly longer ascospores than that described by Spooner (1987) from Australasia.

17. ***Trichophaeopsis bicuspis*** (Boud.) Korf & Erb, Phytologia 24: 18, 1972.

Diagnostic features: Apothecia discoid, sessile. Hairs mostly distributed along margin, seta-like, acute at apex, brown, with a basal prong. Ectal excipulum of textura prismatica, 25-35 µm thick, with cells arranged in rows, cells 10-15 x 10-15 µm in size. Ascospores ellipsoid, 15-20 x 10-13 µm.

Specimen examined: on rotten leaves, Baihuashan, Beijing, W.-y. Zhuang & Z. Wang (1243), 19 IX 1995, HMAS 70322.

PREVIOUSLY REPORTED SPECIES FOR WHICH NEW NAMES ARE REQUIRED

18. *Geoglossum glabrum* Pers.

Diagnostic features: Dried ascocarps stipitate, ascogenous portion very dark brown to black, elongate-lanceolate to elongate-clavate, compressed or not, 2-34 x 1-3 mm, stipe 6-47 x 0.4-1.5 mm. Asci 8-spored, J+ in Melzer's reagent or J- occasionally, 152-203 x 18-23 µm. Ascospores clavate, narrower at the lower end, (51-)59-91(-96) x 5-7 µm, mostly 7-septate. Paraphyses enlarged and moniliform in apical 2-4 cells, straight or curved at apex.

Specimens examined: on the ground, Jizushan, Yunnan, J.-c. Zhou, 9 IX 1938, HMAS 3418; on the ground, Jizushan, Yunnan, J.-c. Zhou, 18 IX 1940, HMAS 3424; on the ground, Jizushan, Yunnan, J.-c. Zhou, 9 IX 1940, HMAS 3449; on the ground, Jizushan, Yunnan, J.-c. Zhou, 8 IX 1938, HMAS 3450; on the ground, Weixi County, Yunnan, S.-j. Han & L.-y. Chen (5204), 19 XI 1958, HMAS 30747; on the ground, Antu County, Jilin, Y.-c. Yang & J.-r. Yuan (1041), 4 IX 1960, HMAS 30748; on the ground, Dailing, Heilongjiang, S. C. Teng (6695), 26 VIII 1963, HMAS 33483; on the ground in forest, Suiyang County, Guizhou, M.-h. Liu (1019), 11 VIII 1987, HMAS 70304.

Notes: Maas Geesteranus (1965) indicated that the above name should be rejected. Examinations of specimens labelled *Geoglossum glabrum* on deposit in HMAS reveal that they are ***Geoglossum cookeianum*** Nannf. Paraphyses of this fungus are enlarged and moniliform in apical 2-4 cells, straight or curved at apex.

19. *Geoglossum glabrum* var. *angustosporum* Tai

Notes: Examinations of the syntypes (Tai, 1944) reveal that this is a later synonym of ***Geoglossum cookeianum*** Nannf.

20. *Geoglossum nigritum* (Fr.) Cooke

Notes: The correct name for most specimens filed under *Geoglossum nigritum* (Fr.) Cooke in HMAS is ***Geoglossum umbratile*** Sacc. since the basionym of the former, *Clavaria nigrita* Pers., is a basidiomycete (Maas Geesteranus, 1965).

21. *Geoglossum nigritum* var. *cheoanum* Tai

Notes: Type examination indicates that this is identical with ***Geoglossum umbratile*** Sacc.

22. *Geoglossum sinense* Tai

= *Geoglossum elongatum* Tai , non Starb.

Notes: Syntypes of this name available in HMAS were examined. They are identical with ***Geoglossum umbratile*** Sacc.

23. *Geoglossum subpumilum* Imai

Notes: Two specimens under this name (HMAS 3443, 4246) cited by Tai (1944) were examined. They are identical with ***Geoglossum pumilum*** G. Winter (Maas Geesteranus, 1965). Ascospores are mostly 15-septate, a few with 12-14 septa.

24. *Microglossum capitatum* Tai

Notes: Syntypes of this name were examined. They are identical with ***Microglossum longisporum*** E. J. Durand (Mains, 1955). When Tai (1944) published the name, he overlooked the presence of one-celled, short ascospores in addition to the normal, long ascospores.

25. *Microglossum tetrasporum* Tai

Notes: The type specimen of this name was examined. It is identical with ***Microglossum longisporum*** E. J. Durand (Mains, 1955). When Tai (1944) published the name, he overlooked the presence of one-celled, short ascospores in addition to the normal, long ascosores.

26. *Mitrula bicolor* Pat.

Notes: Specimens of this fungus are not available. From the description provided by Tai (1979) this fungus might be a species of ***Microglossum***.

27. *Mitrula sclerotiorum* Rostr.

Notes: The correct name for the fungus is ***Episclerotium sclerotiorum*** (Rostr.) Kohn (Kohn & Nagasawa, 1984).

28. *Mitrula shiraiana* (Henn.) S. Ito & S. Imai

Notes: The correct name for the fungus is ***Scleromitrula shiraiana*** (Henn.) S. Imai (1941).

29. *Phillipsia subpurpurea* Berk. & Broome

Teng (1963) recorded this fungus from Guangxi Province. Examinations of specimens in HMAS reveal that the correct name for his record should be ***Phillipsia crispata*** (Berk. & M. A. Curtis) Le Gel. *P. subpurpurea* in the Chinese record may be based on an incorrect identification.

30. *Trichoglossum tetrasporum* Sind. et Fitzp. var. *brevisporum* Tai

Notes: This variety is not distinguishable enough at the variety level . The spore size is within the range of ***Trichoglossum tetrasporum*** Sind. et Fitzp. given by Mains (1954).

NOTES ON A FEW CHINESE GEOGLOSSACEOUS FUNGI

31. ***Geoglossum pusillum*** F. L. Tai

Notes: Maas Geesteranus (1965) treated *Geoglossum pusillum* F. L. Tai as a synonym of *G. pumilum* G. Winter. The examinations of the

Chinese materials of both species indicate that the ascospores of the former are clavate-fusoid, mostly 11-13-septate, 117-143 x 5.5-6.0 µm; those of the latter are cylindrical-clavate, mostly 15-septate, 79-132 x 5.0-7.0 µm. *G. pusillum* is maintained for the time being.

32. ***Trichoglossum cheliense*** F. L. Tai

Notes: Rifai (1965) and Spooner (1987) treated *Trichoglossum cheliense* F. L. Tai as a synonym of *T. hirsutum* (Pers.) Boud. Careful examination of the syntypes reveals that fruitbodies of the former are spathulate, clavate or irregularly lobed, stipes stout, setae extremely dense, and ascospores subcylindrical with the upper end hemispherical and the lower end slightly narrower and 4.5-5.5 µm wide. The latter has a different gross morphology and fusoid-clavate ascospores with both ends narrowed and the lower end even narrower, 5.0-7.0 µm wide. *T. cheliense* should be maintained as a separate species.

33. ***Trichoglossum kunmingense*** F. L. Tai

Notes: When Tai (1944) described the species, he did not mention that in addition to the normal ascospores which are brown, 7-septate, and 85-134 x 5-9(-10) µm, many asci also contain 1-2(-4) small ascospores which are light brown, mostly 3-septate, and 42-59 x 4.5-5.0 µm. This recalls the two different types of ascospores present in *Microglossum longisporum* E. J. Durand.

34. ***Trichoglossum persoonii*** F. L. Tai
? = *Trichoglossum hirsutum* var. *multiseptatum* Mains

Notes: This species is characterized by the 15-22-septate ascospores, 140-210 x 4.5-6.5 µm.

T. hirsutum var. *multiseptatum* Mains (1954) is similar to *T. persoonii* in spore shape, size and number of septa. There is no reason to place a species with 12-22-septate ascospores in *T. hirsutum* (Pers. : Fr.) Boud. which is typically 15-septate. Quite possibly *T. hirsutum* var. *multiseptatum* and *T. persoonii* belong to the same species.

35. ***Trichoglossum yunnanense*** F. L. Tai

Notes: Mains (1954) treated *Trichoglossum yunnanense* F. L. Tai as a variety of *T. tetrasporum* Sindon & Fitzp. It seems that *T. yunnanense* and *T. tetrasporum* are different in spore shape. The ascospores of the former are cylindrical-clavate and 140-175 x 6.0-7.5 µm, while those of the latter are fusoid-clavate and 115-155 x 5.5-7.0 µm. Their sizes of asci differ accordingly. *T. yunnanense* is maintained at the specific level.

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REFERENCES

Denison, W. C. (1972) Central American Pezizales. IV. The genera *Sarcoscypha*, *Pithya*, and *Nanoscypha*. *Mycologia* **64**: 609-623.

Hawksworth, D. L., P. M. Kirk, B. C. Sutton & D. N. Pegler (1995) *Ainsworth & Bisby's Dictionary of the Fungi*. ed. 8. CAB International. Cambridge.

Imai, S. (1941) Geoglossaceae Japoniae. *J. Facul. Agric. Hok. Imp. Univ.* **45**: 155-264.

Kohn, L. M. & E. Nagasawa (1984) The genus *Scleromitrula* (Sclerotiniaceae), *Episclerotium* gen. nov. (Leotiaceae) and allied stipitate-capitate species with reduced ectal excipula. *Trans. Mycol. Soc. Japan* **25**: 127-148.

Le Gal, M. (1953) Les discomycetes de Madagascar. *Prodr. Fl. Mycol. Madagascar et Dep*. **4**: 1-465.

Mains, E. B. (1954) North American species of *Geoglossum* and *Trichoglossum*. *Mycologia* **46**: 586-631.

Mains, E. B. (1955) North American hyaline-spored species of the Geoglosseae. *Mycologia* **47:** 846-877.

Mains, E. B. (1956) North American species of the Geoglossaceae. Tribe Cudonieae. *Mycologia* **48**: 694-710.

Maas Geesteranus, R. A. (1964) On some white-spored Geoglossaceae. *Persoonia* **2**: 81-96.

Maas Geesteranus, R. A. (1965) Geoglossaceae of India and adjacent countries. *Persoonia* **4**: 19-46.

Moravec, J. (1973) *Sowerbyella fagicola* J. Moravec spec. nov., novy druh z Ceskoslovenska. *Ceska Mykol.* **27**: 65-68.

Moravec, J. (1985) A taxonomic revision of the genus *Sowerbyella* Nannfeldt (Discomycetes, Pezizales). *Mycotaxon* **23**: 483-496.

Otani, Y. (1980) Sarcoscyphineae of Japan. *Trans Mycol. Soc. Japan* **21**: 149-179.

Pfister, H. D. (1989) *Kompsoscypha*: a new genus related to *Nanoscypha* (Sarcoscyphaceae). *Mem. N. Y. Bot. Gard.* **49**: 339-343.

Raitviir, A. (1971) The Geoglossaceae of the Far East. pp. 52-83. In Parmasto E. (ed.), *Plant and Animals of the Far East*. Tallin.

Rifai, M. A. (1968) The Australasian Pezizales in the herbarium of the Royal Botanic Gardens Kew. *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede* Sect. **57(3)**: 1-295.

Spooner, B. M. (1987) Helotiales of Australasia: Geoglossaceae, Orbiliaceae, Sclerotiniaceae, Hyaloscyphaceae. *Bibl. Mycol.* **116**: 1-711.

Tai, F. L. (1944) Studies in the Geoglossaceae of Yunnan. *Lloydia* **7**: 146-162.

Tai, F. L. (1979) *Sylloge Fungorum Sinicorum*. Science Press. Beijing.

中国盘菌新种和新记录之七

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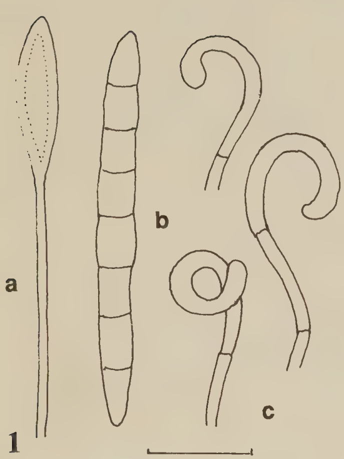
摘要　本文主要记载了作者对地舌菌科、肉杯菌科和少数其它盘菌研究中发现的新分类单元和中国新记录种。亮丝地舌菌 *Geoglossum laccatum*，中国假地杖菌 *Nothomitra sinensis*，毛舌菌阔孢变种 *Trichoglossum hirsutum* var. *latisporum* 和青城毛舌菌 *Trichoglossum qingchengense* 被描述为新分类单元。13 个新记录种包括地舌菌属 *Geoglossum*，艳丽盘菌属 *Kompsoscypha*，小口盘菌属 *Microstoma*，小杯菌属 *Nanoscypha*，歪盘菌属 *Phillipsia*，索氏盘菌属 *Sowerbyella*，小托雷盘菌属 *Torrendiella* 和拟长毛盘菌属 *Trichophaeopsis* 的成员。同时，对 13 个原有记录种的名称做了分类和命名方面的订正，对 5 个地舌菌科盘菌的分类地位进行了评论。

Fig. 1 *Geoglossum laccatum*: **a**. skech of dried ascocarp; **b**. ascospore; **c**. paraphysis apices; scale = 20 μm; from holotype.

Fig. 2 *Nothomitra sinensis*: **a**. skech of dried ascocarps; **b**. ascospores, scale = 15 μm; **c**. paraphysis apices; scale = 20 μm; from holotype.

Fig. 3 *Trichoglossum hirsutum* var. *latisporum*: **a**. skech of dried ascocarp; **b**. ascospores, scale = 25 μm; **c**. paraphysis apices; scale = 20 μm; from holotype.

Fig. 4 *Trichoglossum qingchengense*: **a**. skech of dried ascocarps; **b**. ascospore; **c**. paraphysis apices; scale = 20 μm; from holotype.



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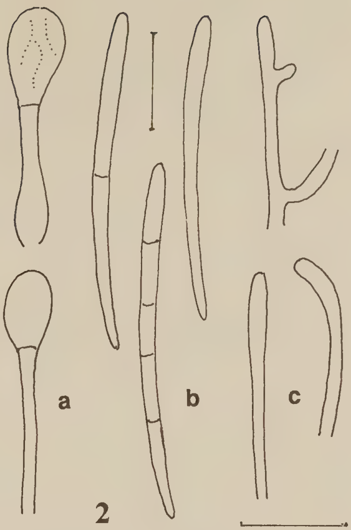

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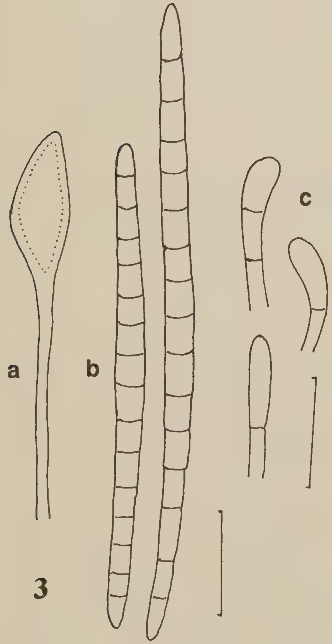

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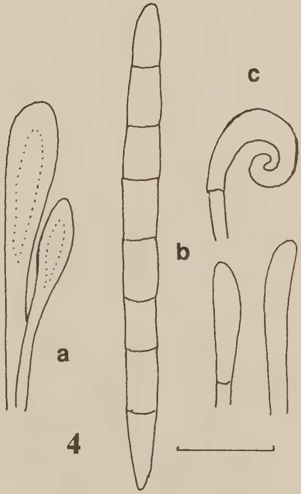

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STUDIES ON MEDITERRANEAN HYPHOMYCETES. VI. REMARKS ON *BACTRODESMIUM*, AND *B. CUBENSE* COMB. NOV.

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Abstract

The mechanism of conidial secession in *Bactrodesmium* Cooke is discussed. A new combination, *B. cubense* (Castañeda & G. Arnold) Zucconi & Lunghini, is proposed for *Trichocladium cubense* Castañeda & G. Arnold.

Keywords: Hyphomycetes, *Bactrodesmium*, *Bactrodesmium cubense*, *Trichocladium cubense*, new combination, Italy.

The genus *Bactrodesmium* was established by Cooke in 1883, and Hughes (1958) chose *B. abruptum* (Berk. & Br.) E. Mason & S. Hughes as a lectotype of the genus. *Bactrodesmium* is characterized by a mostly immersed mycelium, the presence of scattered or clustered and effuse, punctiform, brown or black sporodochia, fasciculate conidiophores and clavate and multiseptate conidia (Ellis, 1959; Holubová-Jechová, 1972).

A feature not yet clearly defined in this genus is the conidial secession, which can be either schizolytic or rhexolytic, sometimes it is reported as dubious and often it is not specified at all. We have examined an *exsiccatum* of the type species of the genus, preserved in the herbarium of Rome (RO) under the name "*Sporidesmium abruptum* B. et Br." (Rabenhorst, *Fungi europaei* No. 1163); the same number of the Rabenhorst herbarium and the type specimen were examined by Ellis (1959). In spite of its bad condition, this *exsiccatum* shows conidia truncated at the base and not provided with any frill, suggesting a schizolytic liberation. Assuming the conidial secession in *Bactrodesmium* s.str. to be schizolytic, the remaining species in the genus should be revised. Among the species described to date in *Bactrodesmium*, only *B. pluriseptatum* Révaj (1993), *B. betulicola* M.B. Ellis (Ellis, 1959; Hughes & White, 1983a), and *B. pithoideum* (Dearn. & House) B. Sutton (Hughes & White, 1983b) are explicitly reported as schizolytic and therefore properly included in the genus. In contrast, the species described as being rhexolytic, *B. obliquum* B. Sutton var. *obliquum* (Hughes & White, 1983c), and var. *suttonii* S. Hughes & G.P. White (1983d), *B. cedricola* M.B. Ellis (Ellis, 1959; Hughes & White, 1983e), and *B. biformatum* (Höhnel) S. Hughes (1983) might have to be excluded, whereas many other species, the majority, for which the conidial secession is reported as dubious - e.g. *B. hebridense* P.M. Kirk (1986) - or not specified, would need further investigation.

During mycological studies on Mediterranean undershrub vegetation, an interesting dematiaceous Hyphomycete was collected in different sites, almost exclusively on leaf litter of *Quercus ilex* L. It was first identified as *Trichocladium cubense* (`*cubensis*') Castañeda & G. Arnold (1985) on the basis of the original description and comparison with holotype slides (INIFAT 84/10, ACC, Cuba) kindly provided by R.F. Castañeda. The species description was based on a collection of leaf litter of *Coccoloba uvifera* L. made in Cuba in 1984. Both in our specimens and the original material, we observed the presence of sporodochia; a sporodochial structure is also well illustrated for the holotype by the authors (Castañeda & Arnold, 1985). This feature suggests little affinity with *Trichocladium* Harz, which is characterized by mononematous and scattered conidiophores (Ellis, 1971). The same consideration had prompted previous combinations of *Trichocladium* species in *Bactrodesmium* (Palm & Stewart, 1982). Moreover, a SEM observation of our specimens clearly showed a schizolytic conidial liberation (Fig. 1c, d), leaving conidia with a truncated closed base, and a flat and closed scar on the conidiogenous locus (Fig. 1d).

For the reasons exposed, *Bactrodesmium* appears to be the appropriate genus in which to accommodate this species, and we propose:

Bactrodesmium cubense (Castañeda & G. Arnold) Zucconi & Lunghini *comb. nov.*

≡ *Trichocladium cubense* Castañeda & G. Arnold, *Rev. Jard. Bot. Nac*. 6: 53, 1985 (basionym) [as `*cubensis*'].

Sporodochia (Fig. 1a, b) amphigenous, scattered or clustered, punctiform, black, shining. Mycelium immersed, forming a thin superficial pseudostroma of compacted, septate and anastomosing

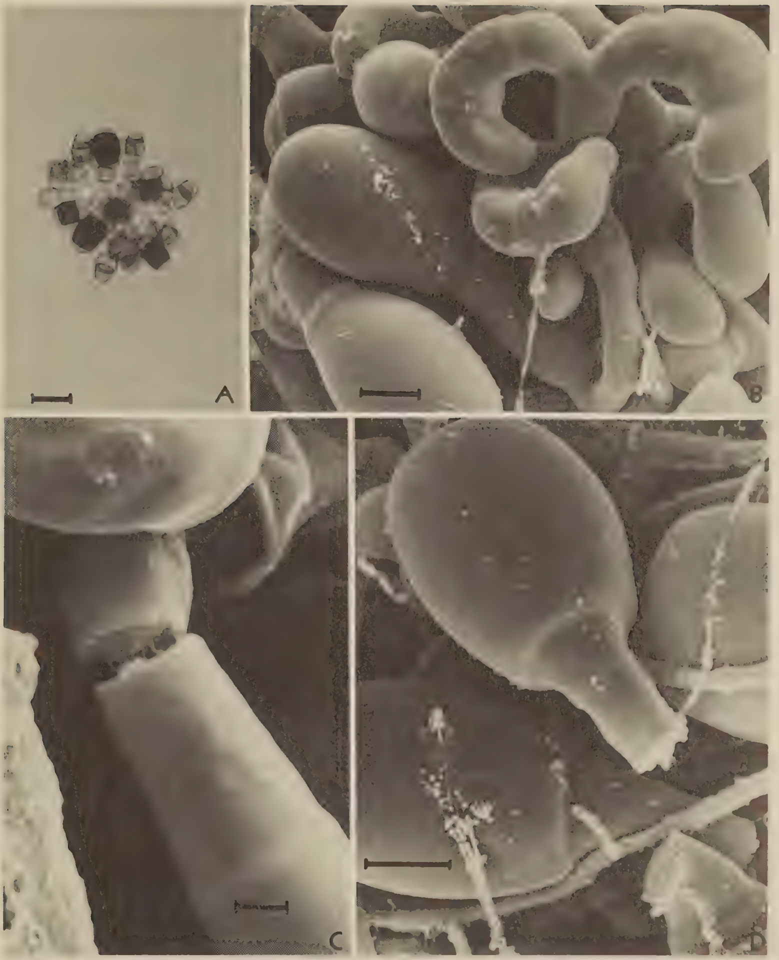

Fig. 1. *Bactrodesmium cubense:* a. light micrograph of a sporodochium (bar = 20 µm); b, SEM showing conidia produced by mono- and polyblastic conidiogenous cells (bar = 5 µm); c and d, SEM showing a conidium and a conidiogenous cell during and after conidial secession, respectively (c, bar = 2 µm; d, bar = 5 µm).

hyphae. Conidiophores arising from pseudostromata, micronematous or semi-macronematous, aggregated, simple or branched, smooth, septate, subhyaline, up to 21 µm and 2.5–4 µm wide. Conidiogenous cells monoblastic or polyblastic (Fig. 1b), integrated, terminal, roundish to clavate, sometimes slightly curved, subhyaline, smooth, 3.8–7.5 × 3.8–6 µm. Conidia (aleurioconidia) solitary, dry, smooth-walled (Fig. 1d), usually curved, broadly clavate, truncate, with a scar at the base up to 6.5 µm wide. Conidium initials subhyaline, thin-walled, sometimes slightly constricted at the dark septa; they increase greatly in size, with the penultimate cell becoming larger and more strongly pigmented; mature conidia 2–3-septate, 15–26 × 8–16 µm, with a larger, thick-walled and very dark brown penultimate cell (up to 17.5 µm long) and a small distal cell which is sometimes collapsed. Secession schizolytic (Fig. 1c, d), sometimes occurring at the base of the conidiogenous cell; occasionally, a breach in the wall of the conidiogenous cell may give rise to conidia bearing a frill at the base.

Colonies on PDA (Difco) attaining 25 mm diam. in four weeks at 24°C, diffuse, with yellowish white to mouse grey, irregularly felty, dense aerial mycelium and blackish reverse. Exudate present. Mycelium partly superficial, partly immersed, composed of branched, subhyaline to dark brown, septate, smooth or somewhat encrusted, 1.8–5 µm wide hyphae. Conidiophores arising laterally from repent and aerial hyphae, crowded and appressed to form sporodochia. Conidiophores, conidiogenous cells and conidia as described on the natural substrate. Single conidia are occasionally produced at the apex of conidiogenous hyphae.

Specimens examined: Castelporziano (Rome), 20.XII.1989, D. Lunghini (ROHB 191); Scaglieri (Elba Island, Livorno), 12.IV.1992, D. Lunghini (ROHB 170); Macchiagrande (Rome), all on leaf litter of *Quercus ilex*, 23.XI.1992, F. Pinzari (ROHB 190); Macchiagrande (Rome), on undetermined wooden branches, 27.IV.1993, F. Pinzari (ROHB 188); Cala Martina (Grosseto), on leaf litter of *Q. ilex*, 13.X.1993, L. Zucconi (ROHB 189); Santiago de las Vegas (Cuba), on leaf litter of *Coccoloba uvifera*, R.F. Castañeda (holotype).

The above reported collections represent new records of the species for Italy and the first records since the original description. A strain, isolated from the specimen recorded on *Q. ilex* at Scaglieri (Elba Island), is preserved at CBS (no. 680.96).

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References

Castañeda Ruiz, R.F. and Arnold, G.R.W. (1985). Deuteromycotina de Cuba. I. Hyphomycetes. *Revista Jard. Bot. Nac. Univ. Habana* 6: 47-67.

Cooke, M.C. (1883). Saccardo's Sylloge Fungorum. *Grevillea* 12: 34-35.

Ellis, M.B. (1959). *Clasterosporium* and some allied Dematiaceae Phragmosporae. II. *Mycol. Pap.* 72: 75 pp.

Ellis, M.B. (1971). *Dematiaceous Hyphomycetes*. Commonw. Mycological Institute, Kew, 608 pp.

Holubová-Jechová, V. (1972). Lignicolous Hyphomycetes from Czechoslovakia 2. *Bactrodesmium*. *Folia Geobot. Phytotax.* 7: 407-418.

Hughes, S.J. (1958). Revisiones Hyphomycetum aliquot cum appendice de nominibus rejiciendis. *Canad. J. Bot.* 36: 727-836.

Hughes, S.J. (1983). *Bactrodesmium biformatum*. *Fungi Canadenses* No. 258.

Hughes, S.J. and White, G.P. (1983a). *Bactrodesmium betulicola*. *Fungi Canadenses* No. 251.

Hughes, S.J. and White, G.P. (1983b). *Bactrodesmium pithoideum*. *Fungi Canadenses* No. 252.

Hughes, S.J. and White, G.P. (1983c). *Bactrodesmium obliquum* var. *obliquum*. *Fungi Canadenses* No. 253.

Hughes, S.J. and White, G.P. (1983d). *Bactrodesmium obliquum* var. *suttonii*. *Fungi Canadenses* No. 254.

Hughes, S.J. and White, G.P. (1983e). *Bactrodesmium cedricola*. *Fungi Canadenses* No. 255.

Kirk, P.M. (1986). New or interesting microfungi XV. Miscellaneous Hyphomycetes from the British Isles. *Trans. Brit. mycol. Soc.* 86: 409-428.

Palm, M.E. and Stewart, E.L. (1982). Two new combinations in *Bactrodesmium*. *Mycotaxon* 15: 319-325.

Révaj, Á. (1993). Some new or interesting Hyphomycetes from Hungary. *Nova Hedwigia* 56: 473-482.

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STUDIES ON MEDITERRANEAN HYPHOMYCETES. VII. *SEPTONEMA CRISPULUM* ANAM.-SP. NOV.

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ABSTRACT - A new dematiaceous hyphomycete, *Septonema crispulum*, found on pine-needle litter in central Italy, is described and illustred.
KEYWORDS: Hyphomycetes, new species, Italy, *Septonema*, *Hormiactella*.

A survey of hyphomycetes associated with mediterranean bush litter in the Reserved Area of World Wildlife Fund (W.W.F.) "Macchiagrande" (Focene, Rome) and in Castelporziano Presidential Estate (Rome), yielded an undescribed species belonging to *Septonema* Corda on decaying dead needles of *Pinus pinea* L.

Septonema crispulum Lunghini et Toscano, anam.-sp. nov. (Figs 1, 2).

Coloniae *minutae, dispersae, luteo-brunneae, setas steriles sursum ferentes.* ***Mycelium*** *plerumque superficiale, ex hyphis ramosis, reticulatis, septatis, levibus, brunneis, 1.5-2 µm crassis compositum.* ***Conidiophora*** *macronematosa, erecta, ramosa, brunnea vel luteo-brunnea, septata, levia, usque ad 90 µm longa et ad basim 3-4 µm crassa, caespitosa.* ***Cellulae conidiogenae*** *terminales, integratae, monoblasticae vel polyblasticae, de-*

terminatae. ***Conidia*** *subcylindrica, utrinque truncata et modice rotundata, pallide luteo-brunnea, uniseptata, modice crassitunicata, 7.6-11.5 x 0.6-1.9 µm, in catenis acropetalibus ramosis, firme cohaerentia; mediae catenae in setulas steriles ramosas, crispulas, luteo-brunneas, usque ad 90 µm longas, gradatim vertuntur.*

In acubus Pini pineae, W.W.F. Reserve Macchiagrande (Focene, Roma), Italia, legit F. Toscano, 15.XI.1992, ROHB 187, holotypus.

Additional specimen: on dead needles of *Pinus pinea*, Castelporziano Presidential Estate (Rome), Italy, legit D. Lunghini, 8.X.1992, ROHB 186, paratypus.

A living culture from the holotype is kept at the Centraalbureau voor Schimmelcultures (Baarn, NL) as CBS 735.96.

Etym.: latin "*crispulus*", curly.

Colonies on natural substratum minute, sparse, yellowish brown, bearing sterile setae on the surface. **Mycelium** mainly superficial, composed of branched, anastomosed, septate, smooth, brown, 1.5-2 µm wide, hyphae. **Conidiophores** macronematous, erect, branched, brown to yellowish brown, septate, smooth, up to 90 µm long, 3-4 µm wide at the base, cespitose. **Conidiogenous cells** terminal, integrated, mono- or polyblastic, determinate. **Conidia** subcylindrical, with truncate, slightly rounded ends and indistinct scars, 1-septate, pale yellowish brown, slightly thick-walled, 7.6-11.5 x 0.6-1.9 µm, in branched, stable, acropetal chains; central chains gradually developing into sterile, curly, branched, yellowish brown, up to 90 µm long, setae.

Colonies on MYA (Malt extract 2 %, Yeast extract 0.1 %, Agar 2 %) attaining 15 mm diam. in 6 weeks at 24°C, effuse, flat, velvety, mouse-grey, reverse blackish. Exudate absent. **Mycelium** mainly immersed, composed of branched, brown to gray-brown, septate, smooth or somewhat rough, anastomosed hyphae, 1.8-3.5 µm in width. **Conidiophores** macronematous or rarely semimacro-

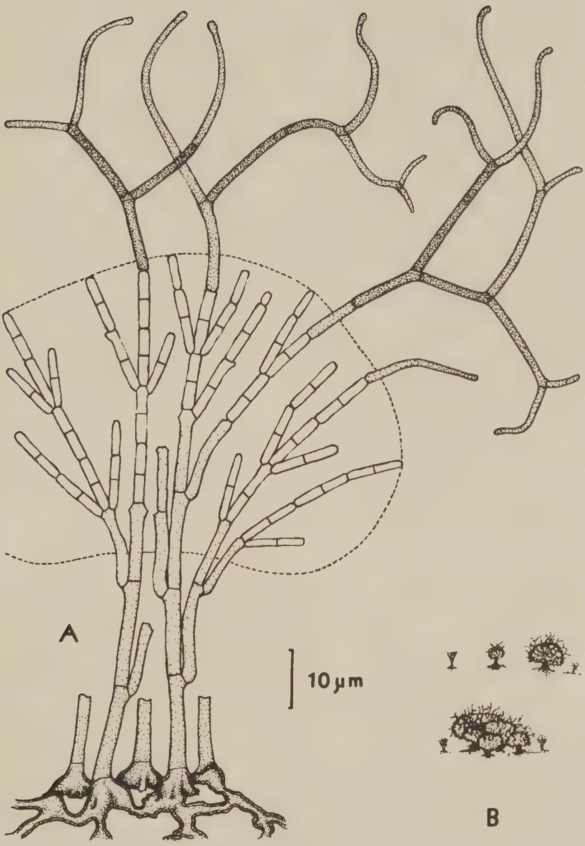

Fig. 1. *Septonema crispulum*: A, conidiophores, conidia and sterile setae; B, colonies on natural substratum.

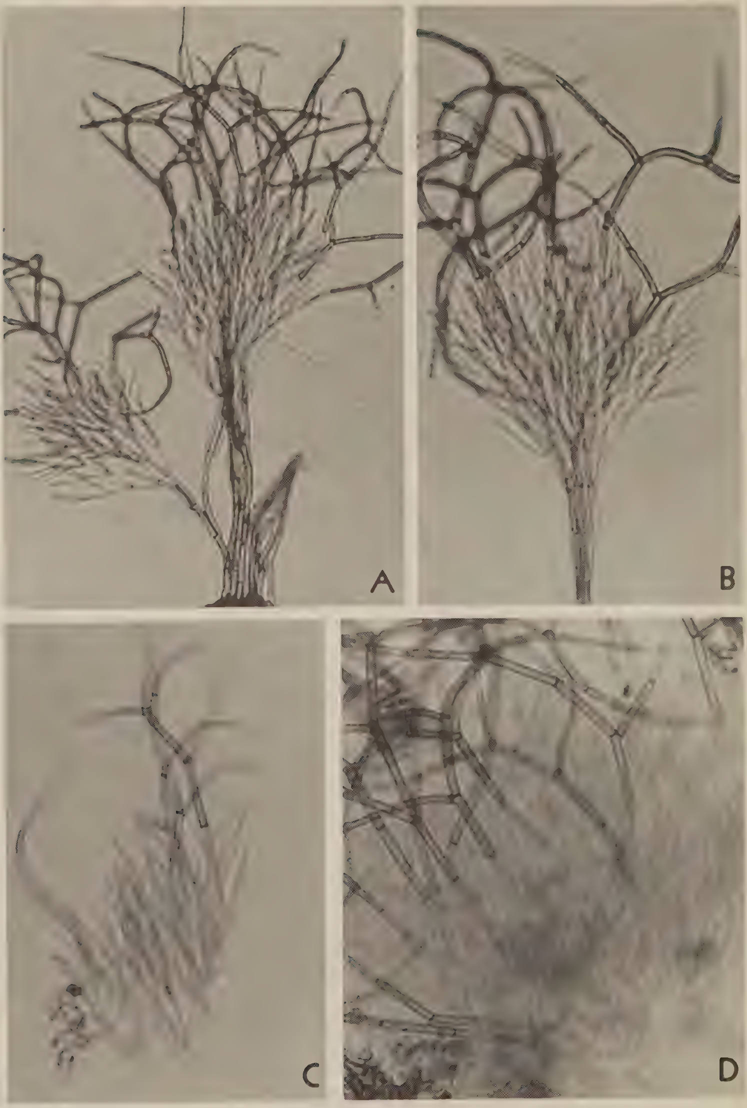

Fig. 2. *Septonema crispulum*: A, general aspect of cespitose conidiophores (x 350); B, detail of conidiophore branching (x 550); C and D, detail of conidial chains and sterile setae (C, x 550; D, x 610).

nematous, branched, brown to yellowish brown, septate, smooth, up to 120 µm long and 2-3 µm wide at the base, solitary or cespitose, arising from repent hyphae. **Conidiogenous cells** terminal, integrated, mono- or polyblastic, determinate. **Conidia** subcylindrical, with truncate, slightly rounded ends, indistinct scars and an hardly visible septum, subhyaline to yellowish brown, 8-13 x 1-3 µm, in branched acropetal chains. **Sterile setae** yellowish brown, up to 180 µm long, slightly curled.

No ascocarps of a teleomorph state were found.

The new species shows characters intermediate between *Septonema* Corda (1837) and *Hormiactella* Saccardo (1886), two closely related genera which are not always easy to separate (Holubová-Jechová, 1978; Kirk, 1982). Particularly the 1-septate and only slightly thick-walled conidia of *S. crispulum* match the characters of *Septonema*, but also resemble those of *Hormiactella*. The sterile setae of *S. crispulum* do not correspond to those of *Hormiactella fusca* (Preuss) Sacc., being formed secondarily from conidial chains, while in *H. fusca* they arise independently from basal hyphae. However, we include our species in *Septonema*, on the basis of its clearly branched conidiophores and stable conidial chains, although sterile setae are not provided for in the generic diagnosis.

Within the genus, *S. crispulum* is similar to *S. pseudobinum* Holubová-Jechová, whose conidia are not very thick-walled, but differ from it, apart from setae, by conidial shape, brittlenes of conidial chains, conidiophore branching, pigmentation, etc; minor affinities are also shown with *S. binum* Borowska (1975), in which, however, conidia are unequally pigmented and "abruptly tapered to the truncate ends".

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REFERENCES

BOROWSKA, A. (1975). New species of *Bactrodesmium, Corynespora, Septonema* and *Taeniolella. Acta Mycol.*, Warsaw, 11: 59-65.

CASTAÑEDA RUIZ R.F. (1988). Fungi cubenses III. *Public. Inst. Fund. Agric. Trop.* "Alejandro de Humboldt", 27 p.

CORDA, A.C.I. (1837). *Icones Fungorum* 1. 1-32.

HOLUBOVA'-JECHOVA', V. (1978). Lignicolous Hyphomycetes from Czechoslovakia 5. *Septonema, Hormiactella* and *Lylea. Folia Geobot. Phytotax.*, Praha, 13, 421-442.

KIRK, P.M. (1982). New or interesting Microfungi IV. Dematiaceous Hyphomycetes from Devon. *Trans. Brit. mycol. Soc.* 78, 55-74.

SACCARDO, P.A. (1886). *Sylloge Fungorum* 4, Padova.

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NEW SPECIES AND NEW COMBINATIONS IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTINA) FROM SOUTH AFRICA

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ABSTRACT : The following new lichen species are described, *Namakwa aliphatica* Elix, *Neofuscelia brussei* Elix, *Neofuscelia quinonella* Elix and *Xanthoparmelia triebeliae.* In addition the new combinations *Canoparmelia antedeluvialis* (Brusse & Sipman) Elix, *Karoowia diutina* (Brusse) Elix, *K. supposita* (Brusse) Elix, *Neofuscelia adamantea* (Brusse) Elix, *N. manina* (Brusse) Elix, *N. parilis* (Brusse) Elix, *N. pristiloba* (Brusse) Elix, *N. vernicosa* (Brusse) Elix, *N. violacea* (Kurok.) Elix, *Paraparmelia agamalis* (Brusse) Elix, *P. asilaris* (Brusse) Elix, *P. dwaasbergensis* (Brusse) Elix, *P. erebea* (Brusse) Elix, *P. fausta* (Brusse) Elix, *P. inops* (Brusse) Elix, *P. lyrigera* (Brusse) Elix, *P. pudens* (Brusse) Elix, *P. nimbicola* (Brusse) Elix, *P. sitiens* (Brusse) Elix, *P. usitata* (Brusse) Elix, *Xanthoparmelia abraxas* (Brusse) Elix, *X. assimilis* (Brusse) Elix, *X. chionophila* (Brusse) Elix, *X. emolumenta* (Brusse) Elix, *X. epacridea* (Brusse) Elix, *X. festiva* (Brusse) Elix, *X. infausta* (Brusse) Elix, *X. lucrosa* (Brusse) Elix, *X. lurida* (Brusse) Elix, *X. mesmerizans* (Brusse) Elix, *X. musculina* (Brusse) Elix, *X. oreophila* (Brusse) Elix, *X. ponderosa* (Brusse) Elix, *X. putida* (Brusse) Elix and *X. tyrrhea* (Brusse) Elix are made.

Introduction

As a result of further study of the lichen family Parmeliaceae in South Africa (Nash & Elix 1987), I am describing four new species. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993; Elix et al. 1988), high performance liquid chromatography (Feige et al. 1993) and comparison with authentic samples.

Namakwa aliphatica Elix, sp. nov. Fig. 1

Species cum thallo ut in *Namakwa exornata* sed ab hac specie acido salazinico noncontinente differt.

Type: Republic of South Africa. Cape Province: Ladismith-Calitzdorp road, 3 km NNW of Droevlei, 33°28'S, 21°28'E, 520 m, on boulders beside creek, *D. Triebel & G. Rambold 7900*, 30 March 1990; holo: M.

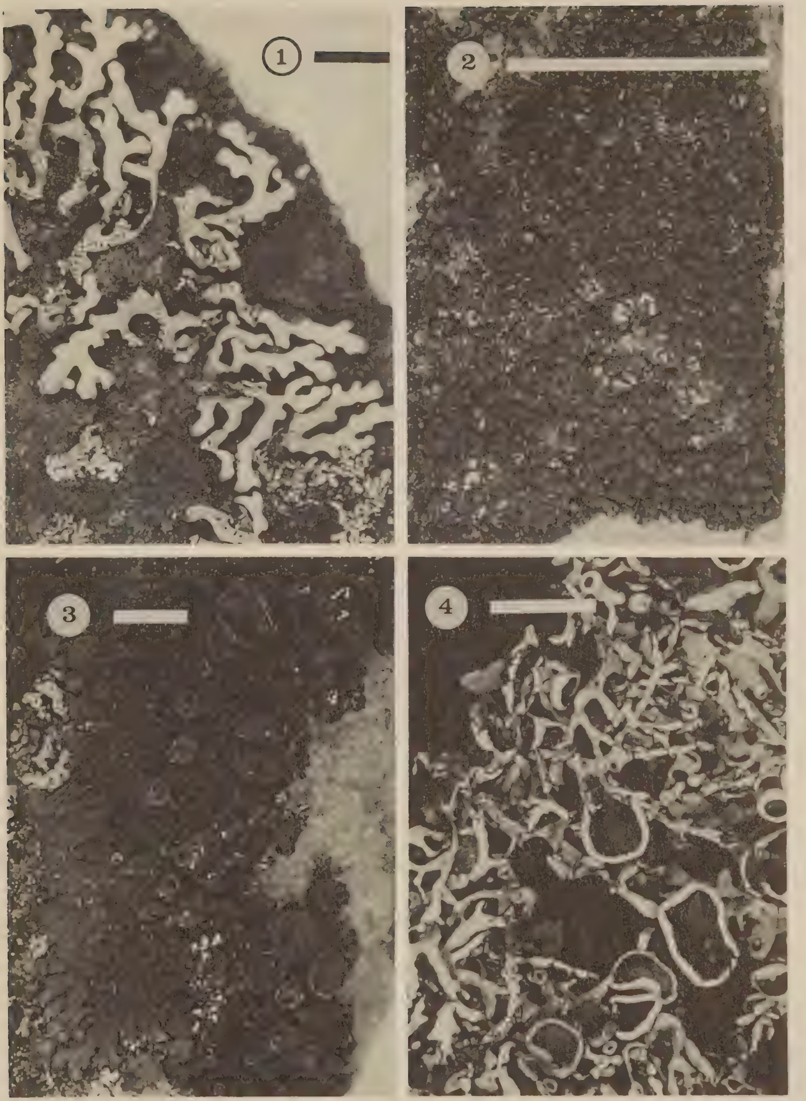
Thallus saxicolous, adnate, firm and leathery, 4–6 cm wide. *Lobes* separate to subimbricate, sublinear to linear-elongate, 1–2 mm wide, dichotomously to subdichotomously branched, flat to convex, the tips often weakly revolute, black-rimmed. *Upper surface* pale to dull yellowish green, darkening towards the centre, strongly maculate-pseudocyphellate, shiny, the pseudocyphellae somewhat depressed, orbicular to irregularly elongate, separate, 0.1–0.5 mm long, lacking soredia and isidia. Medulla white. *Lower surface* pale brown or darkening, flat to weakly convoluted, sparsely to moderately rhizinate, the rhizines pale brown to brown, very coarse, simple to sparsely branched, 1–2 mm long. *Apothecia* not seen. *Pycnidia* common; conidia bifusiform, 4-6 x 0.5 µm.

Chemistry. Cortex K-, medulla K-, C-, KC-, P-; containing usnic acid (major), dehydroprotoconstipatic acid (minor), protoconstipatic acid (minor), dehydroconstipatic acid (minor), constipatic acid (minor), unknown fatty acid (major).

Morphologically *N. aliphatica* closely resembles *N. exornata* (Zahlbr.) Hale, the type species of this genus. These two species have similar, sublinear, dichotomously to subdichotomously branched lobes, a pale lower surface and characteristic pseudocyphellae on the upper surface. However, they are clearly separated by their chemical constituents since salazinic acid, consalazinic acid, ±norstictic acid, ±connorstictic acid, ±chalybeizans unknown and ±fatty acids occur in *N. exornata,* while *N. aliphatica* lacks depsidones, but contains the fatty acids, dehydroprotoconstipatic acid, protoconstipatic acid, dehydroconstipatic acid and constipatic acid. At present this new species is known only from the type locality in Cape Province.

Specimen Examined

REPUBLIC OF SOUTH AFRICA. Cape Province, type locality, *D. Triebel & G. Rambold 7897*, 30 March 1990 (CANB).



Figures 1-4. New species of Parmeliaceae: 1, *Namakwa aliphatica* (holotype in M); 2, *Neofuscelia brussei* (holotype in M); 3, *Neofuscelia quinonella* (holotype in M); 4, *Xanthoparmelia triebeliae* (holotype in M). Scale bar = 5 mm.

Neofuscelia brussei Elix, sp. nov. Fig. 2

Species cum thallo ut in *Neofuscelia parviloba* sed ab hac specie subto nigro et erhizinoso differt.

Type: Republic of South Africa. Cape Province: Jonaskop E of Villiersdorp, rock wall W of television tower, 33°58'S, 19°30'E, *c.* 1600 m, on W-exposed rocks, *D. Triebel & G. Rambold 8556*, 8 April 1990; holo: M; iso: CANB.

Thallus small-foliose to subcrustose, tightly adnate, saxicolous, forming irregular rosettes to 1-2 cm wide, coalescing into larger patches. *Lobes* not or very weakly imbricate, irregular to sublinear, irregularly branched, 0.2-0.8 mm wide. *Upper surface* dark brown to brown-black, flat, smooth and shiny at lobe apices, becoming dull, cracked and areolate in the thallus centre, without isidia. Medulla white. *Lower surface* dull, black, erhizinate, lower cortex attached directly to the substratum. *Apothecia* scattered, ±immersed when young, becoming sessile, to 0.6 mm wide; disc ±flat, brown-black; thalline exciple entire. Ascospores ellipsoidal, 9-11 x 5-6 µm. *Pycnidia* not seen.

Chemistry. Cortex K-, HNO_3+ weak blue-green; medulla K-, C-, KC-, P+ brick red; containing fumarprotocetraric acid (major), protocetraric acid (trace).

Like *Neofuscelia parviloba* (Essl.) Essl. and *N. stygiodes* (Nyl. ex Cromb.) Essl., this new species is characterized by a subcrustose thallus, the lack of isidia and the presence of medullary fumarprotocetraric acid. However, these three species differ in the configuration of the lobes and the morphology of the lower surface. Thus the lobes are flat and thin in *N. brussei* and *N. parviloba*, but are strongly convex, thick and placodioid at the apices in *N. stygiodes*. Furthermore, the lower surface is pale brown and sparsely rhizinate in *N. parviloba*, dark brown to black, lacking rhizines but with loboid holdfasts in *N. stygiodes*, but jet black, erhizinate and attached via the lower cortex in *N. brussei*. At present this new species is only known from the type locality. This species is named in honour of the South African lichenologist, Franklin D. Brusse, in recognition of his significant contributions to the knowledge of the Parmeliaceae in the region.

Neofuscelia quinonella Elix, sp. nov. Fig. 3

Species cum thallo ut in *Neofuscelia vernicosa* sed ab hac specie sporis brevibus et acido divaricatico continente differt.

Type: Republic of South Africa. Cape Province: Waboomsberg, summit, 33°38'S, 20°17'E, 1220 m, on rocks, *D. Triebel & G. Rambold 7969*, 31 March 1990; holo: M.

Thallus foliose, adnate to tightly adnate, saxicolous, forming irregular rosettes, 3-6 cm wide. *Lobes* congested, imbricate, sublinear to subirregular, irregularly branched, 1-2 mm wide. *Upper surface* dark brown to brown-black, the apices flat to moderately convex, shiny, smooth or ±irregularly pitted, older lobes becoming strongly convex, dull, rugose, wrinkled-plicate; lacking soredia and isidia. Medulla red to violet. *Lower surface* pale tan to brown, darker at tips, flat or rugulose; rhizines dense, simple, thick, to 0.5 mm long, clustered, concolorous or darkening. *Apothecia* common, sessile, to 5 mm wide; disc shallowly concave to ±flat or weakly convex, black-brown; thalline exciple thin, margin entire. Ascospores ellipsoidal, 7-8 x 4-5 µm. *Pycnidia* common, globose, immersed. Conidia bacilliform or weakly bifusiform, 5-7 x 1 µm.

Chemistry. Cortex K-, HNO_3+ obscure blue-green; medulla K-, C-, KC-, P- [all obscured by medullary pigments]; containing divaricatic acid (major), oxostenosporic acid (minor), stenosporic acid (trace), unknown quinonoid pigments (major).

This species is characterized by the adnate thallus, the congested, sublinear to irregular lobes with a pale lower surface and the presence of divaricatic acid and red-violet, quinonoid pigments in the medulla. These quinonoid pigments were first identified in *Xanthoparmelia endomiltoides* (Nyl.) Hale, but also occur in *Neofuscelia violacea* (Kurok.) Elix, *N. vernicosa* (Brusse) Elix and *N. parilis* (Brusse) Elix [see below for new combinations]. Morphologically *N. quinonella* closely resembles the latter three species, and can be most reliably distinguished chemically - *N. violacea* containing fumarprotocetraric acid (major), succinprotocetraric acid (minor) and protocetraric acid (trace), *N. parilis* containing protocetraric acid and *N. vernicosa* containing the quinonoid pigments but no additional depsides or depsidones. At present this new species is known only from the type locality.

Xanthoparmelia triebeliae Elix, sp. nov. Fig. 4

Species cum thallo ut in *Xanthoparmelia furcata* sed ab hac specie lobis dense rhizinatis et acido dehydroprotoconstipatico, acido dehydroconstipatico et acido protoconstipatico continente differt.

Type: Republic of South Africa. Cape Province: Jonaskop E of Villiersdorp, rock wall W of television tower, 33°58'S, 19°30'E, *c.* 1600 m, on N-exposed rocks, *D. Triebel & G. Rambold 8584,* 8 April 1990; holo: PRE; iso: CANB.

Thallus foliose, saxicolous, loosely adnate, 4-6 cm wide. *Lobes* loosely imbricate, sublinear-elongate, dichotomously to subdichotomously branched, 0.5-2.0 mm wide. *Upper surface* yellow-green, flat to weakly convex, shiny but becoming dull and darkening with age, smooth to slightly rugulose, lacking maculae, soredia and isidia; margins often blackened towards the tips. Medulla white. *Lower surface* pale tan to light brown, darker at tips; rhizines sparse to moderately dense, simple to dichotomously branched, concolorous, to 3 mm long, often extending beyond the margin. *Apothecia* common, subpedicellate, 1-4 mm wide; disc concave, dark brown; thalline exciple smooth, margin thick, involute, crenulate. Ascospores ellipsoidal, 8.5-10.5 x 5-7 µm. *Pycnidia* common; conidia bifusiform, 5-6 x 0.5 µm.

Chemistry: Cortex K-; medulla K-, C-, KC+ rose, P-; containing usnic acid (major), dehydroprotoconstipatic acid (major), dehydroconstipatic acid (minor), protoconstipatic acid (minor).

Morphologically this new species resembles *Xanthoparmelia furcata* (Müll. Arg.) Hale since both are characterized by loosely adnate thalli and sublinear-elongate, separate lobes with a pale lower surface. However, *X. furcata* has a brown, rugose lower surface with very sparse, short, simple rhizines whereas *X. triebeliae* has a tan to pale brown, smooth lower surface with moderately dense, elongated, ±dichotomously branched rhizines. These species also differ chemically since *X. furcata* contains loxodin and norlobaridone, while *X. triebeliae* contains dehydroprotoconstipatic acid and related fatty acids. At present *X. triebeliae* is only known from the type locality.

Specimen Examined

REPUBLIC OF SOUTH AFRICA. Cape Province, type locality, *D. Triebel & G. Rambold 8588*, 8 April 1990 (CANB).

New Combinations

Canoparmelia antedeluvialis (Brusse & Sipman) Elix, comb. nov.
Basionym: *Parmelia antedeluvialis* Brusse & Sipman, *Mycotaxon* **49**: 1 (1993).

Karoowia diutina (Brusse) Elix, comb. nov.
Basionym: *Parmelia diutina* Brusse, *Mycotaxon* **49**: 2 (1993).

Karoowia supposita (Brusse) Elix, comb. nov.
Basionym: *Parmelia supposita* Brusse, *Mycotaxon* **50**: 294 (1994).

Neofuscelia adamantea (Brusse) Elix, comb. nov.
Basionym: *Parmelia adamantea* Brusse, *Mycotaxon* **40**: 378 (1991).

Neofuscelia manina (Brusse) Elix, comb. nov.
Basionym: *Parmelia manina* Brusse, *Mycotaxon* **49**: 6 (1993).

Neofuscelia parilis (Brusse) Elix, comb. nov.
Basionym: *Parmelia parilis* Brusse, *Mycotaxon* **40**: 383 (1991).

Neofuscelia pristiloba (Brusse) Elix, comb. nov.
Basionym: *Parmelia pristiloba* Brusse, *Mycotaxon* **49**: 8 (1993).

Neofuscelia vernicosa (Brusse) Elix, comb. nov.
Basionym: *Parmelia vernicosa* Brusse, *Bothalia* **15**: 320 (1984).

Neofuscelia violacea (Kurok.) Elix, comb. nov.
Basionym: *Parmelia violacea* Kurok., in Hale & Kurokawa, *Contr. U.S. Natn. Herb.*, **36**: 158 (1964).

Paraparmelia agamalis (Brusse) Elix, comb. nov.
Basionym: *Parmelia agamalis* Brusse, *Mycotaxon* **34**: 399 (1989).

Paraparmelia asilaris (Brusse) Elix, comb. nov.
Basionym: *Parmelia asilaris* Brusse, *Mycotaxon* **31**: 155 (1988).

Paraparmelia dwaasbergensis (Brusse) Elix, comb. nov.
Basionym: *Parmelia dwaasbergensis* Brusse, *Mycotaxon* **35**: 21 (1989).

Paraparmelia erebea (Brusse) Elix, comb. nov.
Basionym: *Parmelia erebea* Brusse, *Mycotaxon* **49**: 4 (1993).

Paraparmelia fausta (Brusse) Elix, comb. nov.
Basionym: *Parmelia fausta* Brusse, *Mycotaxon* **27**: 185 (1986).

Paraparmelia inops (Brusse) Elix, comb. nov.
Basionym: *Parmelia inops* Brusse, *Mycotaxon* **35**: 22 (1989).

Paraparmelia lyrigera (Brusse) Elix, comb. nov.
Basionym: *Parmelia lyrigera* Brusse, *Mycotaxon* **35**: 24 (1989).

Paraparmelia pudens (Brusse) Elix, comb. nov.
Basionym: *Parmelia pudens* Brusse, *Mycotaxon* **27**: 188 (1986).

Paraparmelia nimbicola (Brusse) Elix, comb. nov.
Basionym: *Parmelia nimbicola* Brusse, *Mycotaxon* **27**: 238 (1986).

Paraparmelia sitiens (Brusse) Elix, comb. nov.
Basionym: *Parmelia sitiens* Brusse, *Mycotaxon* **35**: 22 (1989).

Paraparmelia usitata (Brusse) Elix, comb. nov.
Basionym: *Parmelia usitata* Brusse, *S. Afr. J. Bot.* **52**: 107 (1986).

Xanthoparmelia abraxas (Brusse) Elix, comb. nov.
Basionym: *Parmelia abraxas* Brusse, *Mycotaxon* **40**: 377 (1991).

Xanthoparmelia assimilis (Brusse) Elix, comb. nov.

Basionym: *Parmelia assimilis* Brusse, *Mycotaxon* **40**: 379 (1991).

Xanthoparmelia chionophila (Brusse) Elix, comb. nov.
Basionym: *Parmelia chionophila* Brusse, *Mycotaxon* **50**: 291 (1994).

Xanthoparmelia emolumenta (Brusse) Elix, comb. nov.
Basionym: *Parmelia emolumenta* Brusse, *Mycotaxon* **50**: 292 (1994).

Xanthoparmelia epacridea (Brusse) Elix, comb. nov.
Basionym: *Parmelia epacridea* Brusse, *Mycotaxon* **49**: 3 (1993).

Xanthoparmelia festiva (Brusse) Elix, comb. nov.
Basionym: *Parmelia festiva* Brusse, *Mycotaxon* **36**: 305 (1989).

Xanthoparmelia infausta (Brusse) Elix, comb. nov.
Basionym: *Parmelia infausta* Brusse, *Mycotaxon* **36**: 306 (1989).

Xanthoparmelia lucrosa (Brusse) Elix, comb. nov.
Basionym: *Parmelia lucrosa* Brusse, *Mycotaxon* **40**: 380 (1991).

Xanthoparmelia lurida (Brusse) Elix, comb. nov.
Basionym: *Parmelia lurida* Brusse, *Mycotaxon* **31**: 157 (1988).

Xanthoparmelia mesmerizans (Brusse) Elix, comb. nov.
Basionym: *Parmelia mesmerizans* Brusse, *Mycotaxon* **50**: 294 (1994).

Xanthoparmelia musculina (Brusse) Elix, comb. nov.
Basionym: *Parmelia musculina* Brusse, *Mycotaxon* **40**: 381 (1991).

Xanthoparmelia oreophila (Brusse) Elix, comb. nov.
Basionym: *Parmelia oreophila* Brusse, *Mycotaxon* **40**: 382 (1991).

Xanthoparmelia ponderosa (Brusse) Elix, comb. nov.
Basionym: *Parmelia ponderosa* Brusse, *Mycotaxon* **36**: 307 (1989).

Xanthoparmelia putida (Brusse) Elix, comb. nov.
Basionym: *Parmelia putida* Brusse, *Mycotaxon* **40**: 384 (1991).

Xanthoparmelia tyrrhea (Brusse) Elix, comb. nov.
Basionym: *Parmelia tyrrhea* Brusse, *Mycotaxon* **49**: 10 (1993).

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LITERATURE CITED

Culberson, C. F. (1972). Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journal of Chromatography* **72**: 113-125.

Culberson, C. F., Culberson, W. L. and Johnson, A. (1981). A standardized TLC analysis of β-orcinol depsidones. *Bryologist* **84**: 16-29.

Culberson, C. F. and Johnson, A. (1982). Substitution of methyl *tert.*-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *Journal of Chromatography* **238**: 483-487.

Elix, J. A., and Ernst-Russell, K. D. (1993). *A Catalogue of Standardized Thin Layer Chromatographic Data and Biosynthetic Relationships for Lichen Substances,* 2nd Edn. (Australian National University, Canberra).

Elix, J. A., Johnston, J. and Parker, J. L. (1988). A Computer Program for the Rapid Identification of Lichen Substances. *Mycotaxon* **31**: 89-99.

Feige, G. B., Lumbsch, H. T., Huneck, S. & Elix, J. A. (1993) The identification of lichen substances by a standardized high-performance liquid chromatographic method. *Journal of Chromatography* **646**: 417-427.

Nash, T. H. III and Elix, J. A. (1987). New species and new reports in the Parmeliaceae (lichenized Ascomycotina) from South Africa and Australia. *Mycotaxon* **29**: 467-476 (1987).

ERRATA

VOLUME SIXTY-THREE

age 345, line 36	for *Trichosporon roberoi*	read *Trichosporon riberoi*

SEE ERRATA

MYCOTAXON

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NOMENCLATURAL NOTES ON SOME ARTHROCONIDIAL YEASTS

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Abstract. The species *Dipodascus ingens* and its anamorph *Geotrichum ingens* is described. Neotypification of *Trichosporon ovoides* is corrected, and some old names in *Trichosporon* are evaluated.

In a series of publications we have revised the genera *Geotrichum* (de Hoog et al., 1986) and *Trichosporon* (Guého et al., 1992ab) , which are arthroconidial fungi of ascomycetous and basidiomycetous affinity, respectively. Some nomenclatural additions and corrections to these papers are presented below.

Geotrichum

Candida ingens van der Walt & van Kerken is a species in which cells are strongly coherent and later disarticulate into separate cells. It was reclassified by de Hoog et al. (1987) in the filamentous yeast genus *Geotrichum*. The same authors described a teleomorph which was found after crossing of suitable mating partners. This teleomorph showed naked asci which liberated ellipsoidal ascospores with a regular mucilaginous sheath, and was considered to belong to the genus *Dipodascus*. The applied names in *Geotrichum* and *Dipodascus* were attributed to L. Rodrigues de Miranda, who first discovered the teleomorph. However, the corresponding manuscript, listed as "in press", was withdrawn by that author. The following nomenclatural corrections are thus necessary:

Dipodascus ingens de Hoog, M. Th. Smith & Guého, *sp. nov.*

Anamorph: ***Geotrichum ingens*** (van der Walt & van Kerken) de Hoog, M.Th. Smith & Guého, *comb. nov.*

Basionym: *Candida ingens* van der Walt & van Kerken - Antonie van Leeuwenhoek 27: 285, 1961.

Coloniae albidae, butyraceae, modice radiatim sulcatae in zona distali. Hyphae pseudomyceliales, angustatae prope septa; in parte juniore gradatim angustatae, cito in cellulas cylindricas vel ellipsoidales ad 40 µm longas segmentatae. Species heterothallica. Gametangia ex hyphis vice septum vel e cellulis discretis oriunda; asci late ellipsoidei, 12–20 × 10–17 µm, (2–)4 ascosporas continentes, pariete subhyalino, ruptae ascosporas liberantes. Ascosporae (sub-)hyalinae, ellipsoideae, plerumque biguttulatae, 5.5–7.0 × 3.0–4.5 µm, vagina mucida persistente 1–3 µm crassa circumdatae.
Holotypus exsiccatus e culturis incrociatis CBS 7197 × 4827 in herb. CBS praeservatus.

Colonies whitish, butyrous, with somewhat radially furrowed expanding zone. Hyphae pseudomycelial, narrowed at the septa; hyphae gradually becoming narrower towards the tip, soon disarticulating into cylindrical or ellipsoidal cells up to 40 µm in length. Heterothallic. Gametangia formed from opposite sides of hyphal septa or on discrete cells; asci broadly ellipsoidal, 12-20 x 10-17 µm, containing (2-)4 ascospores. Ascus wall subhyaline, liberating ascospores by rupture of the ascus wall. Ascospores (sub)hyaline, ellipsoidal, usually with two droplets, 5.5-7.0 x 3.0-4.5 µm, with persistent mucilaginous sheath 1-3 µm thick.

Holotype of *Dipodascus ingens:* CBS 7197 x 4827, dried culture maintained at the Centraalbureau voor Schimmelcultures, Baarn.

Trichosporon

In our recent revision of basidiomycetous arthroconidial yeasts (Guého et al., 1992ab), the history of *Trichosporon* species causing human and animal white piedra was reviewed. Recently we discovered two additional described *Trichosporon* species that should be evaluated:

Trichosporon glycophile du Bois - Ann. Dermatol. Syphil. 4: 447-456, 1910.
Trichosporon ribeiroi Moraes - Cultura Méd. 3: 1-18, 1941.

No authentic material is known to be preserved of either species. *Trichosporon glycophile* was isolated from a crural white piedra of a pregnant woman. This matches with the prevalent clinical picture *T. inkin*, but in culture *T. glycophile* was quite different by producing heads of blastoconidia on a pseudomycelium, rather than arthroconidia. It seems likely that the described culture was *Candida albicans*, while the specimen on the hairs may have been *Trichosporon inkin.* Since the author doubtlessly meant to describe the piedra, the name *T. glycophile* must represent a *Trichosporon* species rather than a *Candida.* Which species of *Trichosporon* was concerned cannot be established with certainty. *Trichosporon roberoi* was described from white piedra of capital hairs. Its colonies of *T. ribeiroi* were reminiscent of those of *T. inkin*, but the latter species has thus far not been reported from capital hairs. The taxon is of doubtful identity.

The oldest recognizable name in *Trichosporon,* corresponding to the original description of *Trichosporon* by Behrend (1890), was judged to be *T. ovoides*. This species was neotypified by strain CBS 7556 (Guého et al., 1992a). In their Table 1, however, this number was erroneously printed with the name *T. beigelii*. The correct typification of the genus *Trichosporon* is as follows:

Trichosporon Behrend; type species: *Trichosporon ovoides* Behrend; dried neotype specimen (maintained at Centraalbureau voor Schimmelcultures, Baarn, The Netherlands), prepared from living culture CBS 7556.

References

Behrend, G. 1890. Über Trichomycosis nodosa (Juhel-Rénoy): Piedra (Osorio). Berl. Klin.Wochenschr. 27: 464-467.

Guého, E., Hoog, G.S. de & Smith, M.Th. 1992a. Neotypification of *Trichosporon*. Antonie van Leeuwenhoek 61: 285-288.

Guého, E., Smith, M.Th., Hoog, G.S. de, Billon-Grand, G., Christen, R. & Batenburg-van der Vegte, W.H. 1992b. Contributions to a revision of the genus *Trichosporon*. Antonie van Leeuwenhoek 61: 289-316.

Hoog, G.S. de, Smith, M.Th. & Guého, E. 1986. A revision of the genus *Geotrichum* and its teleomorphs. Stud. Mycol. 29: 1-131.

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NEW SPECIES OF *RUSSULA* FROM CALIFORNIA

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The diversity of the mushroom genus *Russula* in California has received very little attention since the somewhat sporadic publications of Burlingham (1-4) during the earlier part of this century. She described a few new species from this state as well as reporting the presence of some of the more common, previously described species. A more recent investigation of this genus was that of Peters (8) who wrote a masters thesis while attending San Francisco State University describing the *Russula* species found in Jackson State Forest located along the northern coast in the vicinity of Mendocino. Unfortunately her results were never published, however her collections are on deposit at the H. D. Thiers Herbarium at San Francisco State University. The purpose of the present paper is to publish descriptions of eight undescribed species of this genus discovered while investigating its diversity in the entire state. The holotypes are deposited in the herbarium at San Francisco State University. The complete results of this investigation will appear later as a contribution from Mad River Press as a part of the Agaricales of California project.

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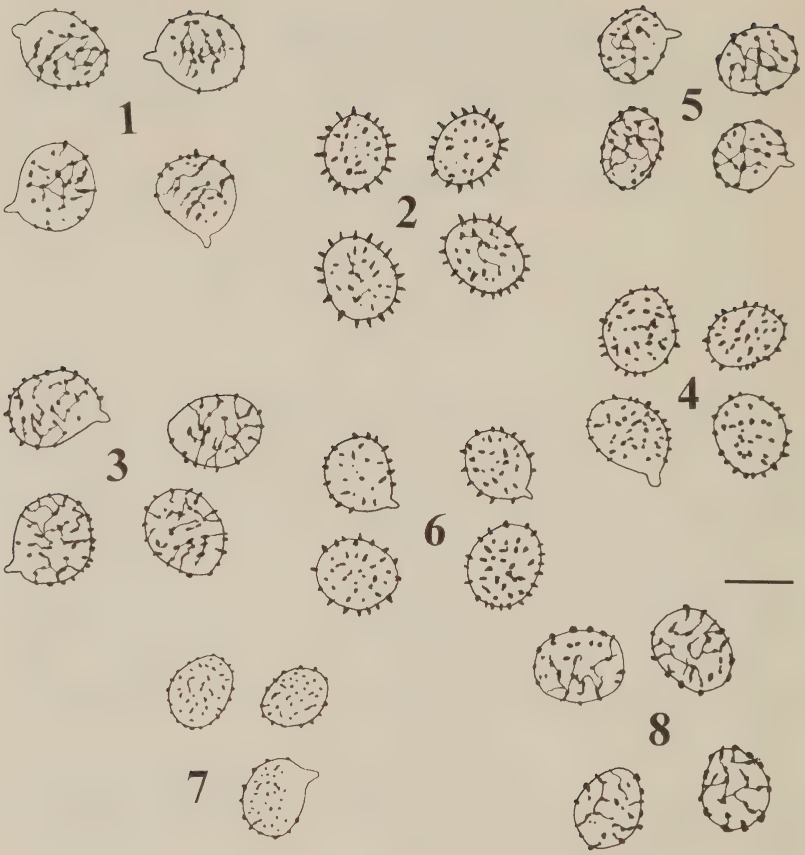
Russula grundii sp. nov. Fig. 1

Pileus 5-9 cm latus, convexus dein planus, demum subdepressus, glaber, viscidus vel subviscidus, margine pallide luteus et interdum roseo-tinctus, disco plerumque atroluteus, odore piscis, in sicco persisti. Lamellae adnexae vel librae, luteae vel ochraceo-luteae, interdum furcatae; lamellulae nullae. Sapor plusminusve piscis vel mitis vel subacris. Stipes 4-8 cm longus, apice 1.5-2 cm crassus, albus; superficies veneta in ferri sulphate. Basidiosporae in cumulo subluteae vel luteae, 7.5-10.5 x 7.5-8.5 µm; reticulum partiale; verrucae 0.5-1.0 µm altae. Hymenii cystidia 80-124 x 5-8 µm, rara vel dispersa, saepe obscura, profunde inclusa in hymenio, fusoidea vel subclavata, apicibus angustatis, elongatis. Cuticula 70-90 µm crassa, epicutis ex hyphis intertextis et pileocystidiis clavatis constans. Holotypus: H. D. Thiers 51840 *(SFSU), Rancho Los Flores prope Los Alamos, Santa Barbara Co., California, 2 February 1988.*

Pileus 5-9 cm broad at maturity, convex to broadly convex when young, plane to broadly and shallowly depressed with age; margin decurved to incurved when young, remaining decurved or occasionally becoming plane to uplifted to undulating when old, smooth when young but sometimes striate with age; cuticle separable 1/3-1/2 the distance



FIGS. 1-8. Basidiospores of *Russula*. 1. *R. grundii*. 2. *R. pacifica*. 3. *R. xanthoporphyrea*. 4. *R. sierraensis*. 5. *R. burgeae*. 6. *R. ellenae*. 7. *R. punicea*. 8. *R. mendocinensis*. Scale line = 5 μm.

to the disc; surface moist to subviscid, glabrous, not rimose or areolate; color pale yellow on the margin, sometimes with faint pinkish tinges, slightly darker on the disc, near pale brownish yellow or darker, not changing color when bruised; context 2-4 μm thick, white, firm, unchanging when exposed. Odor weakly of fish or shrimp, sometimes persisting in dried collections. Lamellae adnate, adnexed or rarely free with age, close to subdistant, forking sometimes common, white to pale yellow when young, yellow to near brownish yellow with age, not changing color when bruised, margin entire, concolorous. Lamellulae absent. Taste mild to weakly acrid. Stipe 4-8 cm long, 1.5-2 cm broad at the apex, equal to subclavate, stuffed, surface dry, smooth, glabrous, white with no flushes of other colors, unchanging in color when bruised; context white, firm, unchanging in color when bruised,

$FeSO_4$ blue green on stipe, darkening to gray brown; context staining red with aniline.

Basidiospores pale yellow to yellow in deposit, 7.5-10.5 x 7.5-8.5 µm, subovoid to subglobose; ornamentation composed of numerous isolated warts with scattered heavy ridges and fine lines, often forming a partial reticulum, warts 0.5-1 µm high. Hymenial cystidia 80-124 x 5-8 µm, usually very obscure, rare to scattered, deeply embedded in the hymenium, fusoid to subclavate with a narrowed, tapered apex. Subhymenium strongly differentiated, several cell layers thick, not gelatinous, pseudoparenchymatic. Sphaerocysts in scattered clusters in lamellar trama. Cuticle 70-90 µm thick, epicutis of rather closely interwoven, hyaline hyphae with scattered free hyphal tips and well differentiated, clavate pileocystidia; subcutis compact, tightly interwoven. Sphaerocysts in well defined clusters in pileal trama.

Known only from a single collection made in an open oak savannah.

The yellow spores, mild to slightly acrid taste, often fishy or shrimp odor, gray green discoloration of the context with iron sulfate and the red reaction with aniline characterize this species. It appears to have a very close relationship with the *R. xerampelina* complex but the basidiomata are small and the pileus is yellow with no purple or reddish pigments present. This species is named in honor of Darrell W. Grund who first recorded its existence, so far as is known, in his doctoral dissertation (5) presently on file at the University of Washington, Seattle.

Russula pacifica sp. nov. Fig. 2.

Pileus 6-9 cm latus, convexus, demum subdepressus, non striatus, glaber, viscidus vel subviscidus, atropurpureus vel subpurpureus, disco saepe flavo- vel olivaceo-tinctus. Lamellae interdum ad stipi confertae vel subdistantes, maturitate flavae, tem furcatae; lamellulae nullae. Sapor mitis. Stipes 5-8 cm longus, apice 1-2.5 cm crassus, albus, griseus vel ater ubi contusus, immutabilis in ferri sulfate. Basidiosporae flavae in cumulo, 7.5-9.4 x 6.6-8.3 µm, non reticulate; verrucae 0.5-1.0 µm altae. Hymenii cystidia 50-64 x 9-12 µm, dispersa, ex hymenio procurrantia, fusoidea vel clavata apicibus elongatis et gradatim angustatis. Cuticula 130-200 µm crassa; epicutis ex hyphis erectis et pileocystidiis dispersis constans. Holotypus: H. D. Thiers 50763 *(SFSU), Big Lagoon area, State Highway 101 prope Patrick's Point State Park, Humboldt Co., California, 10 May 1986.*

Pileus 6-9 cm broad when mature, convex to plano-convex when young, broadly and shallowly depressed when mature, uplifted to undulating when old; margin incurved when young then decurved, plane when old, often eroded, not striate; cuticle separable 1/3-1/2 the distance to the disc; surface viscid to subviscid when moist, glabrous; color dark purple to light purple, often with yellowish to olivaceus tints on the disc, not markedly changing in color when bruised, context 3-4 µm thick, white, firm, unchanging in color when exposed. Odor mild, not distinctive. Lamellae adnate to adnexed, sometimes becoming subdecurrent with age, close to subdistant, thick, sometimes forking at stipe, whitish when young, yellow with age. Lamellulae absent. Taste mild. Stipe 5-8 cm long, 1-2.5 cm broad at apex, more or less equal to subclavate, dry, glabrous, somewhat longitudinally ridged, stuffed to hollow, white, staining gray to blackish when bruised, no reddish interphase; context white, changing to gray to blackish when exposed. $FeSO_4$ and aniline staining context yellow; no reaction with phenol.

Basidiospores yellow in deposit, 7.5-9.4 x 6.6-8.3 µm, subellipsoid to nearly globose; ornamentation composed of numerous coarse, isolated warts with few heavy ridges and scattered connecting lines, no reticulum; warts ±1 µm high. Hymenial cystidia 50-64 x 9-12 µm, scattered, projecting from hymenium, hyaline to pale yellow in KOH, some with amorphous contents, fusoid to clavate with a tapering, elongated apex. Subhymenium poorly differentiated. Sphaerocysts in crowded clusters in the lamellar trama. Cuticle 130-200 µm thick, epicutis gelatinous, differentiated as a turf of erect to semi-erect, free hyphal tips, opaque hyphae irregularly distributed, with scattered pileocystidia which give a positive SV reaction; subcutis not strongly differentiated. Sphaerocysts in scattered clusters in the pileal trama.

Gregarious in soil in a Sitka spruce forest.

This species is distinguished by two major characters; the blackening of the stipe when bruised and the very distinctive chemical reactions of reagents on the context. This is the only species encountered which gave no reaction with phenol, and a yellow reaction to aniline. It is readily distinguished from other species which stain black or gray with age or when bruised by the color of the pileus and other features enumerated above.

Russula xanthoporphyrea sp. nov. Fig. 3.

Pileus 5.5-8 cm latus, convexus tum planus vel depressus, qlaber, viscidus vel subviscidus, porphyreus vel atroporphyreus, maculis luteis; contextus luteus ubi expositus; in kalii hydroxido contextus roseus et pilei superficies vivande rubra. Lamellae subdistantes, maturitate subluteae, non furcatae vel anastomosantes; lamellulae rarae vel absentae. Sapor mitis. Stipes 4-6 cm longus, 1-2 cm brassus, albus, plerumque violaceo-vel luteotinctus. Basidiosporae pallide luteae in cumulo, 9-11 x 6-8 µm; reticulum completum; verrucae 0.2-0.5 µm high. Hymenii cystidia 46-92 x 4-13 µm , abundantia, ex hymenio procurrantia, teretia vel subclavata, apicibus anguste elongatis. Cuticula 80-120 µm crassa; epicutis ex hyphis laxe internexis constans; pileocystidia nulla. Holotypus: H. D. Thiers 34958 *(SFSU), Huntington Lake, Fresno Co., California, 28 September 1975.*

Pileus 5.5-8 cm broad at maturity, convex to broadly convex when young, expanding to plano-convex, and eventually plane with a shallow, broad to relatively narrow depression when mature; margin incurved when young, then decurved, unchanging or becoming noticeably uplifted and often undulating with age, not or only obscurely striate; cuticle separable 1/3-1/2 the distance to the disc; surface glabrous, viscid to subviscid when wet, KOH staining the cuticle bright red; color purple, often dark purple when young with yellow blotches on the disc, or purple on the disc and scattered yellow areas on the margin, fading only slightly when old; context 0.6-1.5 cm thick, firm, white, staining yellowish when exposed, staining distinctly pink with KOH. Odor mild, not distinctive. Lamellae adnate to adnexed, close to subdistant, broad, somewhat ventricose, forking or anastomosing absent, whitish, pale yellow with age, unchanging in color or becoming slightly darker yellow when bruised. Lamellulae rare to absent. Taste mild. Stipe 4-6 cm long, 1-2 cm broad at the apex, clavate to subclavate, occasionally subbulbous at the base, dry, glabrous, solid to stuffed; white, usually with noticeable lavender or yellow flushes; context white to whitish, unchanging in color when exposed.

Basidiospores pale yellow in deposit, 9-11 x 6-8 µm, subglobose to subovoid, occasionally ovoid; ornamentation composed of short heavy ridges usually forming a well defined partial to complete reticulum, isolated warts rare to absent, connectives present, sometimes common; warts up to 0.5 µm high. Hymenial cystidia 46-92 x 4-13 µm, common to abundant, projecting from the hymenium, terete to rarely subclavate with narrowed, elongated apices, thin-walled, contents darkening slightly in SV. Subhymenium thick, well defined, not gelatinous, pseudoparenchymatic. Sphaerocysts crowded in the lamellar trama, binding hyphae absent. Cuticle 80-120 µm thick, epicutis differentiated as a tangled, loosely interwoven layer of hyaline, gelatinous hyphae, pileocystidia absent; subcutis a somewhat narrow layer of small, compact cells. Sphaerocysts in clusters in the pileal trama.

Scattered to gregarious in humus in dense conifer forest. Known only from the type collection.

This is the only species found in California in which KOH gave a bright red reaction on the pileipellis and stained the context of the pileus pink to red. It is further characterized by the purple color of the pileus with yellow blotches irregularly distributed, the yellow staining context when exposed, the white stipe that usually has yellow blotches and/or yellow or lavender tints, and the absence of pileocystidia. Similar species that occur in California include *R. lilacea* which has white spores and *R. murrillii* which has pale yellow spores and no yellow spots or blotches on the pileus.

Russula sierrensis sp. nov. Fig. 4.

Pileus 5.5-7.5 cm latus, convexus demum depressus, glaber, viscidus vel subviscidus ubi madidus, rufo-purpureus vel pallidior, saepe flavo-maculatus. Lamellae maturae pallide flavae, plerumque subdistantes, rare furcatae vel anastomosantes; lamellulae dispersae variabiles in longitudine. Sapor mitis. Stipes 4-6 cm longus, apice 1-2 cm crassus, albus. Basidiosporae in cumulo pallide flavae, 7-8.5 x 6-7 µm, non reticulate; verrucae 0.5-1.0 µm altae. Hymenii cystidia 54-85 x 4-12 µm, dispersa, ex hymenio procurrantia, clavata vel fusoidea, apicibus acutis vel subacutus. Cuticula 100-150 µm crassa; epicutis ex hyphis laxe internexis et pileocystidiis dispersis, clavatis vel subclavatis constans. Holotypus: H. D. Thiers 52894 *(SFSU). U.S. Forest Service Campground, State Highway 49, ca. prope Downieville, Sierra Co., California, 9 October 1989.*

Pileus 5.5-7.5 cm broad when mature, convex to broadly convex when young, plane to shallowly to moderately deeply depressed with age; margin incurved only slightly when young, broadly decurved and often eventually uplifted to undulating when old, not or only obscurely striate; cuticle separable up to 1/2 the distance to the disc; surface glabrous, viscid to subviscid when wet; color reddish purple to pale purple, often with yellow blotches irregularly dispersed, unchanging with age or fading slightly with yellow areas becoming more common, not changing color when bruised; context 0.5-1 cm thick, firm, white, unchanging in color when exposed. Odor mild, not distinctive. Lamellae adnate to adnexed, close to subdistant, more often subdistant, rarely forking or anastomosing, white to whitish when young, pale yellow as spores mature, unchanging in color when bruised. Lamellulae scattered, of varying lengths. Taste mild. Stipe 4-6 cm long, 1-2 cm broad at the apex, clavate to subclavate, rarely equal, dry, glabrous. somewhat rugulose, solid to stuffed; white with no tints or flushes of other colors; context white, brittle, unchanging in color when exposed.

Basidiospores pale yellow in deposit, 7-9.5 x 6-7 µm, subglobose to subovoid, rarely susbellipsoid; ornamentation composed almost exclusively of scattered to common, coarse warts, heavy ridges uncommon, connective lines absent, not reticulate; warts 0.5-1 µm high. Hymenial cystidia 54-85 x 4-12 µm, abundant, rarely scattered, mostly conspicuous and projecting from the hymenium, clavate to fusoid with acute to subacute to narrow, tapering elongated apices, contents darkening in SV, pale yellow in KOH, thin-walled. Subhymenium strongly differentiated, thick, pseudoparenchymatic, yellowish in KOH, not gelatinous. Sphaerocysts in compact, rather crowded clusters in the lamellar trama. Cuticle 100-150 µm thick; epicutis a broad layer of loosely interwoven, hyaline, gelatinous hyphae with scattered, clavate to subclavate pileocystidia, darkening only slightly in SV; subcutis relatively narrow, compact, cells small. Sphaerocysts in scattered, discrete clusters in the pileal trama.

Gregarious to scattered in soil in oak-pine woodlands.

This species is distinguished by the reddish purple to pale reddish purple color of the pileus with conspicuous yellow blotches, mild taste, pale yellow spores that lack a reticulum, the presence of pileocystidia and a white stipe that does not develop flushes or tints of other colors. The only other somewhat similar species in California is *R. paludosa* which has yellow to dark yellow spores that are reticulate and a white stipe that typically becomes at least partially red with age.

Russula burgeae sp. nov. Fig. 5.

Pileus 4-8 cm latus, convexus demum subdepressus, striatus el tuberculato-striatus, glaber, humidus vel subviscidus, margine albus vel pallide flavus vel bubalinus, disco plerumque atroflavus vel atrobubalinus. Lamellae primo albae, demum subflavae, interdum irregulariter furcatae; lamellulae nullae. Sapor dilute acris vel acris. Stipes 4-8 cm longus, apice l-1.5 cm crassus, albus. Basidiosporae in cumulo flavae vel subflavae, 6.7-9 x 5.7-7.3 µm; reticulum partiale; verrucae 0.3-0.5 µm altae. Hymenii cystidia 41-75 x 8-14 µm, dispersa vel abunda, ex hymenio procurrantia, fusoidea vel clavata, apicibus obtusis vel gradatim elongatis. Cuticula 180-250 µm crassa; epicutis ex hyphis laxe internexis et pileocystidiis paucis, dispersis constans. Holotypus: Peters 608 *(SFSU). Little Lake Road, Jackson State Forest, Mendocino Co., California. 10 October 1961.*

Pileus 4-8 cm broad at maturity, convex to plano-convex, unchanging or broadly and shallowly depressed with age; margin decurved, smooth to striate when young, tuberculate-striate with age; cuticle not easily separable from the context; surface glabrous, moist to subviscid; color white to whitish to pale yellow to pale brownish yellow on the margin, darker yellow to brownish yellow on the disc, unchanging in color when bruised; context 1-3 mm thick, firm, compact, white, unchanging in color when exposed. Odor mild, not distinctive. Lamellae adnexed to adnate, becoming notched with age, close to subdistant, forking at irregular intervals, whitish when young, pale yellow as the spores mature, unchanging in color when bruised. Lamellulae absent. Taste weakly acrid to acrid. Stipe 4-9 cm long, 1-1.5 cm broad at the apex, clavate to irregular to, rarely equal, dry, glabrous, stuffed to hollow, white during all stages, unchanging in color when bruised; context white, unchanging in color when exposed.

Basidiospores pale yellow to yellow in deposit, 6.7-9 x 5.7-7.3 µm, ovoid to subellipsoid to subglobose; ornamentation composed of scattered, isolated warts and heavy ridges, often forming a broken reticulum; warts up to 0.5 µm high. Hymenial cystidia 41-75 x 8-14 µm, scattered to abundant, sometimes crowded, projecting from the hymenium, fusoid to clavate with an obtuse to narrow, elongated, somewhat acute terminal appendage. Subhymenium more or less gelatinous, compact. Sphaerocysts in discrete clusters in the lamellar trama, inconspicuous, apparently confined to the central strand of the trama. Cuticle up to 250 µm thick; epicutis differentiated as a layer of gelatinous, tangled to loosely interwoven hyphae with numerous free hyphal tips and occasional to scattered pileocystidia; subcutis compactly interwoven, gelatinous. Sphaerocysts in discrete clusters in the pileal trama.

Gregarious and often common in mixed conifer-hardwood forests.

This species is named in honor of Tana Burge (nee Peters) who first discovered it while doing a masters thesis (8) on the genus *Russula* in the coastal regions of northern California. This species is most likely to be confused with *R. albidula*. *Russula burgeae*, however, has a darker colored pileus which is usually colored pale yellowish brown or darker yellow. In addition, *R. albidula* has significantly larger spores and the heavy warts on the spores are only up to 0.5 µm high but in *R. burgeae* they are up to 1 µm high. Also the pileus margin in *R. burgeae* is consistently striate to tuberculate-striate whereas this character occurs only rarely in *R. albidula*.

Russula ellenae sp. nov. Fig. 6.

Pileus 2-3.5 cm latus, convexus demum planus, glaber, viscidus vel subviscidus, primo roseus vel corallinus, disco flavo, demum omnino flavus. Lamellae pallide lutae, nec furcatae, nec anastomosantes; lamellulae rarae vel absentes. Sapor acris, interdum mitis. Stipes 4-5 cm longus, apice 0.5-1 cm crassus, albus, saepe subroseo-tinctus, tactu immutabilis. Basidiosporae in cumulo pallide luteae, 7.6-9.5 x 6.0-7.5 µm; reticulum partiale; spinae 0.3-0.7 µm altae. Hymenii cystidia 55-70 x 9-12 µm, plerumque in hymenio inclusa, clavata vel cylindrica, apicibus angustatis vel obtusis. Cuticula 150-200 µm crassa; epicutis ex hyphis implicatis vel laxe intertextis et pileocystidiis numerosis, distinctissimis constans. Holotypus: H. D. Thiers 50893 *(SFSU), Jackson State Forest, Mendoocino Co., California, 13 November 1986.*

Pileus 2-3.5 cm broad at maturity, convex to plano-convex to near plane, usually with a broad to slight depression with age; margin decurved when young, unchanging or becoming plane when older, entire, not striate; cuticle separable for only a short distance toward the disc; surface viscid to subviscid when moist, glabrous, smooth; color rose to pink to coral pink with no lavender or purple shades when young, with yellow areas when very young on the disc, sometimes with yellow over the entire pileus except the margin, umbo pinkish yellow during all stages, unchanging in color when bruised; context 2-3 µm thick, white, firm, unchanging in color when exposed. Odor mild, not distinctive. Lamellae close to subdistant, adnexed to adnate, very narrow, thin, no forking or anastomosing, whitish when young, pale yellow with age, no stains apparent, unchanging in color when bruised. Lamellulae rare to absent. Taste acrid, sometimes weakly so. Stipe 4-5 cm long, 0.5-1 cm broad at the apex, equal to enlarging toward the base, dry, glabrous, stuffed, white, often with pinkish tints or flushes, unchanging in color when bruised; context white, unchanging in color when exposed.

Basidiospores pale yellow in deposit, 7.6-9.5 x 6-7.5 µm; ornamentation composed mostly of isolated spines and warts, heavy ridges and connectives rare to absent; when present, rarely forming an obscure partial reticulum; warts 0.3-0.7 µm high. Hymenial cystidia 55-70 x 9-12 µm, scattered, deeply embedded in the hymenium, hyaline to pale yellow in KOH, clavate to cylindric with tapered, obtuse apices. Subhymenium not strongly developed, pseudoparenchymatic, not gelatinous. Sphaerocysts crowded, not in discrete clusters in the lamellar trama and no binding hyphae apparent. Cuticle 150-200 µm thick; epicutis differentiated as a layer of hyaline, gelatinous, tangled to loosely interwoven hyphae with numerous free hyphal tips and well differentiated pileocystidia that stain dark brown in SV; subcutis narrow, hyaline, compactly interwoven. Sphaerocysts in scattered, distinct clusters in the pileal trama.

Gregarious in dense conifer-hardwood forest.

It is a pleasure to name this species in honor of Ellen Thiers who not only collected the holotype but also assisted in every aspect in the fulfillment of this project. *Russula ellenae* is distinguished by the small size of the pileus, the rose to coral pink color of the pileus with no vinaceous or lavender shades, the presence of yellow areas that sometimes eventually cover all of the pileus except the margin. It is most likely to be confused with *R. veternosa* but in that species the pileus is lavender pink to peach color, has a odor of honey and dark yellow spores. *Russula ellenae* best fits in subsection *Lepidinae* of section *Piperinae*, but the pileus is not velutinous and there is no menthol or bitter taste.

Russula punicea sp. nov. Fig.7

Pileus 5-7 cm latus, convexus, immutabilis vel aetate planus vel depressus, glaber, viscidus vel subviscidus, atrorufus vel atropurpureus. Lamellae maturae flavae, nec furcatae nec anastomosantes; lamellulae nullae. Sapor peracris. Stipes 5-7 cm longus, apice 1-2 cm crassus, albus plusminusve fuscus ubi contusus. Basidiosporae in cumulo flavae, 8.3-9.6 x 6.6-7.5 µm, non reticulatae; verrucae 0.3-0.7 µm altae. Hymenii cystidia 57-71 x 7-12 µm, numerosa, ex hymenio vix procurrantia, teretia vel fusoidea, ad apices subangustata. Cuticula 90-120 µm crassa; epicutis tenuis, ex hyphis internexis et pileocystidiis numerosis constans. Holotypus: H. D. Thiers 49714 *(SFSU), Big Lagoon, State Highway 101 near Trinidad, Humboldt Co., California, 10 May 1985.*

Pileus 5-7 cm broad at maturity, convex to plano-convex, unchanging or plane to shallowly depressed with age; margin incurved when young, decurved to near plane at maturity, entire, striations absent; cuticle separable for only a short distance toward the disc; surface glabrous, subviscid to viscid when moist; evenly colored very dark red to very dark purplish red, no other colors present, unchanging in color with age or becoming slightly paler on the margin, unchanging in color when bruised; context 3-5 µm thick at the disc, white, very firm, unchanging in color when exposed. Odor mild, not distinctive. Lamellae adnate to occasionally adnexed, close to subdistant, more often subdistant, no forking or anastomosing, whitish when young, yellow as the spores mature, unchanging in color when bruised. Lamellulae absent. Taste strongly acrid. Stipe 5-7 cm long, 1-2 cm broad at the apex, typically enlarging toward the base, sometimes clavate to subclavate, dry, glabrous, stuffed or solid, white, often darkening slightly when bruised; context white, unchanging in color or darkening very slightly when exposed.

Basidiospores yellow in deposit, 8.3-9.6 x 6.6-7.5 µm, subellipsoid to subglobose;

ornamentation composed of coarse, isolated heavy warts, heavy ridges and connectives rare to absent, not reticulate; warts 0.3-0.7 µm high. Hymenial cystidia 57-71 x 7-12 µm, numerous, projecting slightly from the hymenium, terete to fusoid with slightly tapering apices, usually with amorphous contents, pale yellow in KOH, walls often thickened. Subhymenium poorly defined, gelatinous. Sphaerocysts rare in the lamellar trama. Cuticle 90-190 µm thick; epicutis differentiated as a rather narrow layer of very loosely interwoven to tangled to turf-like, hyaline, gelatinous hyphae, with numerous free hyphal tips and well differentiated pileocystidia; subcutis strongly differentiated and conspicuous. Sphaerocysts in scattered clusters in the pileal trama.

Gregarious in soil and mosses under Sitka spruce. Known only from the type collection.

In addition to the yellow spores and acrid taste this species is distinguished by the evenly distributed, very dark red or very dark purple color of the pileus with no other colors present. The stipe is white and darkens only very slightly when bruised with no additional flushes or tints present. The spores are not reticulate and heavy ridges and connectives are usually absent. Pileocystidia are present and well differentiated.

Russula mendocinensis sp. nov. Fig. 8

Pileus 10-13 cm latus, convexus tum planus demum subdepressus, glaber, viscidus vel subviscidus, subpurpureus vel vinaceus, plerumque maculis flavis vel subroseo-brunneis. Lamellae maturitate atroluteae, nec furcate nec anastomosantes; lamellulae inaequales, sparsae. Sapor acris. Stipes 6-8 cm longus, apice 2-3 cm crassus, albus. Basidiosporae flavae in cumulo, 8-9 x 6-8 µm; reticulum partiale; verrucae 0.5-1.0 µm altae. Hymenii cystidia 54-69 x 12-15 µm, rara vel dispersa, ex hymenio procurrantia, clavata vel fuscoidea, apices versus elongata et gradatim angustata. Cuticula 150-200 µm crassa; epicutis ex hyphis implicatis vel intertextis et pileocystidiis dispersis constans. Holotypus: H. D. Thiers 53479 *(SFSU). Forest Road 409, Jackson State Forest, Mendocino Co., California. 13 December 1990.*

Pileus 10-13 cm broad when mature, convex to plano-convex with an incurved margin when young, plane to shallowly and broadly depressed with age; margin decurved to plane to uplifted, undulating with age, not striate; cuticle separable for 1/3-1/2 the distance to the disc; surface glabrous, viscid to subviscid when wet; color light purple to vinaceous, usually with blotches of yellow or sometimes pinkish brown; no olive pigments present, colors persisting with little or no change with age; not changing color when bruised, context 1.5-2 cm thick, white, firm, unchanging in color when exposed. Odor mild, not distinctive. Lamellae adnate to adnexed, close to subdistant, no forking or anastomosing, white to whitish when young, dark yellow when the spores are mature, unchanging in color when bruised. Scattered lamellulae of varying lengths. Taste promptly acrid. Stipe 6-8 cm long, 2-3 cm broad at the apex, equal to subclavate, dry, glabrous, stuffed, white with no flushes or tints of other colors, unchanging in color when bruised; context white, unchanging in color when exposed.

Basidiospores yellow in deposit, 8-9 x 6-8 µm, mostly subovoid to subellipsoid or subglobose; ornamentation composed of scattered heavy warts and numerous heavy ridges forming a partial to near complete reticulum, fine lines rare to absent; warts 0.5-1.0 µm high. Hymenial cystidia 54-69 x 12-15 µm, rare to apparently absent in some portions of the hymenium, projecting from the hymenium, clavate to fusoid with somewhat elongated, tapering apices, contents black in SV, near hyaline in KOH, walls somewhat thickened. Suhymenium rather narrow, compact, pseudoparenchymatic, pale yellow in KOH. Sphaerocysts in crowded clusters in the lamellar trama. Cuticle 150-200 µm thick; epicutis differentiated as a rather broad layer of tangled to loosely interwoven, hyaline, gelatinous hyphae; pileocystidia well differentiated, scattered, with blackened contents in SV, subcutis not strongly differentiated, compact, pale yellow in KOH. Sphaerocysts in crowded clusters in the pileal trama.

Known only from a single collection. Gregarious to scattered in soil in mixed conifer-hardwood forest.

This species is distinguished by the light purple to vinaceous pileus that sometimes develops irregularly distributed yellow or pinkish areas, the promptly acrid taste, the yellow reticulate spores, white stipe with no tints or flushes of other colors, and the presence of well defined pileocystidia. *Russula mendocinensis* seems to fit best in the subsection *Rubinae* of section *Piperinae.* There is only one other member of this section presently recorded from the state. It is *R. punicea*, which has a dark red to dark purple pileus.

BIBLIOGRAPHY

1. Burlingham, G. S. (1913). The Lactarieae of the Pacific Coast. - Mycologia 5:305-311.

2. Burlingham, G. S. (1915). Lactarieae. - No. Amer. Flora 9(4):201-236.

3. Burlingham, G. S. (1936). New or Noteworthy Species of *Russula* and *Lactaria.* - Mycologia 28:253-267.

4. Burlingham, G. S. (1944). Studies in North American Russulae. - Mycologia 38:104-120.

5. Grund, D. W. (1965). A Survey of the Genus *Russula* Occurring in Washington State. - Doctoral Dissertation, Dept. of Botany, University of Washington, Seattle, WA. 396 pp.

6. Kibby, G. & R. Fatto (1990). Keys to the Species of *Russula* in Northeastern North America. - 3rd. Ed. Kibby & Fatto Enterprises, New York. 61 pp.

7. Knudsen, H. & J Stordall (1992). *Russula.* - In: Knudsen, H. et al. Nordic Macromycetes. Vol. II. Nordsvamp, Copenhagen: 374-401.

8. Peters, H. A. (1962). Studies in the Genus *Russula* Fr. in Northern California. - Master's Thesis, Dept. of Biology, San Francisco St. Univ., San Francisco California. 98 pp.

9. Romagnesi, H. (1967). Les Russules d'Europe et d'Afrique du Nord. - Bordas, France. 998 pp.

10. Shaffer, R. L. (1972). North American Russulas of the Subsection *Foetentinae.* - Mycologia 64: 1008-1053.

11. Shaffer, R. L. (1975). Some Common North American Species of *Russula* Subsection *Emeticinae.* - Beih. Nova Hedw. 51: 207-237.

12. Singer, R. (1988). The Agaricales in Modern Taxonomy. - 4th Ed. Koeltz, Germany. 981 pp.

13. Smith, A. H., H. V. Smith & N. S. Weber (1979). How to Know the Gilled Fungi. - Wm. C. Brown, IA. 334 pp.

14. Woo, B. (1985). *Russula*, Trial Key to the Pacific Northwest Species. - Northwest Key Council, Seattle, WA. 33 pp.

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GENERIC CONCEPTS WITHIN THE GROUPS OF *MARASMIUS* AND *COLLYBIA* SENSU LATO

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In the first part of their monograph on *Marasmius* and *Collybia* sensu lato in Europe, Antonín and Noordeloos (1993) gave a historical survey of the genera. *Marasmius* was elaborately defined in this treatise, and the authors promised to return to the subject and make a more definitive account of the generic concepts in *Collybia* sensu lato that will appear in a later installment (Antonín and Noordeloos 1997). While preparing this latter treatment, generic concepts in the group concerned have been the subject of much discussion among us and has caused one of us to reassess generic relationships (e.g., Halling 1994).

As pointed out in historical surveys (Halling 1983, Antonín & Noordeloos 1993), *Collybia* remained ill-defined for a long time and comprised many elements later transferred to genera such as *Tephrocybe*, *Lyophyllum*, *Oudemansiella*, *Xerula*, *Strobilurus*, *Baeospora*, etc. Thanks to the works of Singer (1949-1986) and Kühner (1980), many of these collybioid segregates have been accepted as distinct genera that are often remote from one another in the Tricholomataceae sensu lato.

Taxonomic position of *Marasmiellus*. Kühner (1933) created *Marasmius* sect. *Rameales* to accommodate species formerly placed in *Marasmius* with the following characters: non-hymeniform pileipellis, but rather a trichoderm-like structure of inflated terminal elements that often bear numerous, small, finger- and/or wart-like projections. This type of structure, which is perfectly developed in *M. ramealis*, was therefore called a "Rameales-structure." In addition, the species of sect. *Rameales* have an insititious, non-filiform stipe, contrary to the species of the Patoulliardian genus *Androsaceus*. However, a rather large variation in the pileipellis structure of *Marasmiellus* has become accepted. The range includes a rather simple cutis with some irregular, erect to suberect terminal elements with hardly any "Rameales-structure," to a well-developed structure, as in the type species, *M. juniperinus* Murrill. Singer (1948, 1949) reintroduced the genus *Marasmiellus* and emended the concept several times. At that time, several taxa of *Hemimycena* and *Rickenella* were included. In his most recent monograph of Neotropical species, Singer (1973) developed a concept that has become ±stable to the present (compare Singer 1986). This concept was employed by Antonín and Noordeloos (1993) in their treatment of European taxa.

Taxonomic position of *Micromphale*. Kühner (1933) created sect. *Gloeonemae* in *Marasmius* to accommodate *M. foetidum*. This species was characterized by the intercellular gelatinization of the trama in pileus, lamellae, and stipe, in combination with an insititious stipe and repent hyphae in the pileipellis. Later, he (Kühner 1936) added *Marasmius perforans* to sect. *Gloeonemae* mainly because of the fetid odor, but also because of the slight gelatinization of the hyphae in the pileipellis. However, the kind of ixocutis in *M. perforans* is not comparable to the gelatinized trama of *M. foetidum*. Singer (1949) placed both species in his emended concept of *Micromphale*. It should be noted, however, that *Micromphale*, in its original sense, included not only *Mi. foetidum* (as type species under the name *M. venosum*), but also species such as *Marasmius rotula* and *Rickenella fibula*. Murrill (1916) also placed *Lyophyllum ulmarium* in *Micromphale*. His concept of the genus was: "Pileus fleshy, putrescent, flabelliform to subcircular in outline; lamellae adnate or sinuate; spores hyaline, sometimes becoming lilac tinged; stipe more or less eccentric, solid; veil none." – a concept that basically encompassed pleurotoid taxa. In the emended concept of Singer, *Micromphale* appeared to be clearly different from *Marasmius*, mainly on account of its pileipellis, but also the genus was significantly different from *Collybia* on account of its insititious stipe and fetid odor. Kühner and Romagnesi (1953), in their delimitation of *Marasmius* sect. *Foetidi* placed *M. foetidium* and *M. perforans* with *M. brassicolens*, *M. acicola*, *M. cauvetii*, and *M. impudicus* based on the characteristic fetid odor. However, besides the absence of gelatinized tissues, those latter species differed from *M. foetidum* and *M. perforans* by the presence of a non-insititious stipe. Dennis, Orton, and Hora (1960) combined all species from *Marasmius* sect. *Gloeonemae* in *Micromphale*, thus emending the concept of *Micromphale* by accepting both gelatinized and non-gelatinized taxa with or without an insititious stipe. In his four editions of the Agaricales in Modern Taxonomy, Singer (1949-1986) restricted the concept of *Micromphale* to include only those species with an insititious stipe and transferred all other taxa to *Collybia*. Kühner (1980) gave an extensive account of the problems in classifying the *Micromphale* and *Marasmiellus*-like taxa and made clear that the concept of *Micromphale*, based solely on the gelatinous trama and insititious stipe, did not justify a distinction from *Marasmiellus* at the generic level. The pileipellis structure found in both genera is similar and so, he synonymized *Micromphale* with *Marasmiellus*. Based on this information (and our own observations), we adhere to this disposition.

Taxonomic position of *Collybia*. The genus *Collybia* has a long history (Halling 1983, Antonín & Noordeloos 1993). In the concepts of Halling (1983) and Singer (1986), the genus has been generally characterized by the cutis-like pileipellis and non-insititious stipe. However, after examining the genus intensively on a narrower scale (North Temperate Zone), and generally with a broader biogeographic perspective, it seems to us that *Collybia* s.l. is rather heterogeneous. Let us first consider the structure of the pileipellis. In concepts outlined earlier by Singer and Halling, the pileipellis of a typical *Collybia* could be a simple cutis or ixocutis (sections *Collybia* and *Maculatae*), a cutis of entangled, non-diverticulate or coralloid hyphae (sects. *Iocephalae* and *Vestipedes*), a complex cutis often with transitions to a trichoderm made up of inflated, lobed or coralloid terminal elements, often referred to as a "dryophila-type" structure (sect. *Levipedes*), and a cutis with diverticulate hyphae (sect. *Subfumosae*) (n.b.: sect. *Cystidiatae* has already been dealt with by Halling 1989). Critical study of the pileipellis types in European species of *Collybia* revealed that the variation in the four last mentioned sections is far larger than previously thought. The type of pileipellis structure of sect. *Iocephalae* is a simple cutis, but other characters (e.g, pigmentation and chemical characters) would isolate *C. iocephala*; the only true member of that section (*C. syringea* belongs in *Pseudobaeospora*). Such classical *Vestipedes* taxa, like *C. confluens* and *C. peronata*, can show obvious diverticulate elements in the pileipellis (Jansen 1991), and therefore one could assign them to sect. *Subfumosae*. The variation in the so-called "dryophila-type" structure, as found in *C. dryophila*, is so great that there seems to be no clear hiatus between the typical structure and the type of pileipellis described as characteristic for sect. *Subfumosae*. *Collybia fusipes*, considered by some to be related to the *maculata* group (apparently because of a fibrous-textured basidioma and a pink-tinted spore deposit reported in some literature, e.g. Singer 1973, under sect. *Striipedes*). Indeed, *C. fusipes* has a fibrous texture, but, in reality, it also has a white spore deposit, and the spore walls are unreactive with Melzer's Reagent, thus precluding any alignment with the *maculata* group. The pileipellis type in *C. fusipes* is rather similar to the "dryophila-type" structure. Also, species such as *Micromphale brassicolens*, *M. inodora*, and *M. cauvetii* have a pileipellis structure very similar to some species placed by Halling (1983) in sect. *Subfumosae* (viz., *C. hariolorum*, *C. impudica*, *C. tergina*, and *C. putilla*). Because of this continuum in the structure of the pileipellis in sections *Vestipedes*, *Levipedes*, *Iocephalae, Striipedes,* and *Subfumosae*, we believe taxa of these sections form a natural group (in the genus *Gymnopus*, see below).

The pileipellis type found in the remaining groups, viz. sections *Collybia* and *Maculatae*, are definitely different and more like a simple cutis of ±radially arranged, smooth hyphae sometimes embedded in a gelatinous matrix. If we take into account that the *maculata* group (we have excluded *C. fusipes*) has additional deviating characters in the form of a distinctly colored spore deposit (pink to pale orange tints) and spores that are often dextrinoid and cyanophilous, then we have no difficulty in recognizing those taxa in the independent genus *Rhodocollybia* Singer. In this regard we are in agreement with Lennox (1979). The group of taxa around *C. tuberosa* (sect. *Collybia* sensu Halling 1983 and Singer 1986) differs not only in the above mentioned pileipellis structure, but also in a completely different habit and ecology in that they occur on or near mummified Basidiomycetes and often form sclerotia and conidia. Therefore, we would exclude this group from *Collybia* sensu Halling and Singer. This is in line with the generic concept of *Microcollybia* (Lennox 1979). However, the name *Collybia* is conserved with *C. tuberosa* as type (see below). The remaining Collybias then seem to be a more homogeneous group which can be united under the generic name *Gymnopus* (Pers.) Roussel (see below). The differences between *Gymnopus* and *Marasmiellus* are, however, very small. There is a great resemblance in pileipellis structure between both genera, and in fact, the only real difference between the two is found in the insititious stipe of *Marasmiellus* and the basal mycelium in *Gymnopus*. On the other hand, *Setulipes* Antonín forms an intermediate between *Marasmiellus* and *Marasmius* with its insititious stipe and a pileipellis that frequently starts as a hymenoderm in young specimens but later always develops into an irregular trichoderm with a Rameales-like structure.

Other segregates from the traditional concept of *Collybia* are nowadays considered to have a more remote taxonomic position, viz., *Baeospora*, *Strobilurus*, *Xerula*, *Oudemansiella*. Among other things, they have a quite different tramal structure which would place them in a separate group (stirps Xerulae in Singer) or in the family Xerulaceae (Jülich 1981, Redhead 1987).

Nomenclatoral consequences. The proposed delimitation of genera poses some nomenclatoral problems. First is the disposition of the name *Marasmiellus* in the present concept. *Micromphale* S. F. Gray (1821) and *Collybiopsis* (J. Schroet.) Earle (1909) represent older synonyms and have priority over the name *Marasmiellus* Murrill (1915). This implies that, if we accept the proposed synonymy of *Marasmiellus* and *Micromphale*, the latter name must replace the former one. Alternatively, one would be obliged to use *Collybiopsis* for *Marasmiellus*. Considering that the name *Marasmiellus* has been in current use for a long time and comprises many hundreds of species, and *Micromphale*, in its current use (Singer 1986), includes only about 10 species, and so far, *Collybiopsis* has hardly been used at the generic rank (Horak 1968, 1971), it seems best to conserve the name *Marasmiellus* against both. A formal proposal has been made (Antonín, et al. in prep.). Awaiting the decision of the nomenclature committee, we continue the use of *Marasmiellus* in the present concept. We do not accept the nomenclatoral view of Honrubia (1984) who transferred most European *Marasmiellus* species to *Micromphale*.

The generic name *Collybia* has been typified with *C. tuberosa* and is, as such, conserved against *Gymnopus* (typified by *G. fusipes*). We accept this typification and consequently do not use *Microcollybia*. We therefore take up the generic name *Gymnopus* (Pers.) Roussel, Fl. Calvados, ed. 2: 62. 1806, for the group of collybioid fungi with a white to cream-colored spore print, a non-insititious stipe, and an entangled to coralloid pileipellis.

KEY TO GENERA OF COLLYBIOID AND MARASMIOID FUNGI IN EUROPE

1. Pileipellis a true hymenoderm..*Marasmius*

1. Pileipellis a true hymnoderm only in primordial state or otherwise..2

  2. Stipe insititious..3

  2. Stipe pseudoinsititious or with basal mycelium..6

3. Pileus with long, setiform hairs that are often thick-walled..4

3. Pileipellis lacking such hairs..5

4. Basidiomata marasmioid or collybioid with centrally inserted stipe............................*Crinipellis*

4. Basidiomata pleurotoid with laterally attached stipe..*Chaetocalathus*

5. Pileipellis sometimes initially hymeniform, but later becoming an irregular trichoderm composed of diverticulate hyphae mixed with broom cells; hyphae of stipe apex dextrinoid.....................*Setulipes*

5. Pileipellis a cutis from the beginning, sometimes with transitions to a trichoderm, typically composed of diverticulate hyphae, sometimes with a Rameales-structure, rarely with only a few projections or (almost) smooth; hyphae never dextrinoid...*Marasmiellus*

6. Spore deposit pink to orange tinted when fresh; spores usually dextrinoid and cyanophilous; pileipellis a cutis or ixocutis of smooth hyphae..*Rhodocollybia*

6. Spore deposit white to cream colored; spores never dextrinoid or cyanophilous; pileipellis composed of smooth to irregular to diverticulate hyphae...7

7. Pileipellis a cutis or ixocutis of narrow, cylindrical hyphae, without projections or diverticulate endings, lacking encrusting pigments; basidiomata small, often growing from a sclerotium in or around mummified remnants of Basidiomycetes...*Collybia*

7. Pileipellis a cutis or trichoderm, made of hyphae with none to few or numerous projections, or with lobed to diverticulate terminal elements, frequently with encrusting pigment; basidiomata growing on other substrata, and rarely originating from a sclerotium..*Gymnopus*

New combinations: In the following list of taxa, we provide new combinations for those binomials known to us requiring recombination in the appropriate genus (or section) that reflects our current concepts of *Gymnopus*, *Collybia*, *Rhodocollybia*, and *Marasmiellus*.

Gymnopus sect. *Iocephalae* (Singer ex Halling) Halling, comb. nov.
Basionym: *Collybia* sect. *Iocephalae* Singer ex Halling, Mycologia Mem. 8: 32. 1983.

Gymnopus sect. *Vestipedes* (Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Agaricus* subtribus *Vestipedes* Fr., Epicr. 86. 1838.

Gymnopus alkalivirens (Singer) Halling, comb. nov.
Basionym: *Collybia alkalivirens* Singer, Sydowia 2: 26. 1948.

Gymnopus alpinus (Vilgalys & O. K. Mill.) Antonín & Noordel., comb. nov.
Basionym: *Collybia alpina* Vilgalys & O. K. Mill., Trans. Brit. Mycol. Soc. 88: 465. 1987.

Gymnopus aquosus (Bull.:Fr.) Antonín & Noordel., comb. nov.
Basionym: *Agaricus aquosus* Bull., Herb. France pl. 17. 1780-1781.

Gymnopus benoistii (Boud.) Antonín & Noordel., comb. nov.
Basionym: *Collybia benoistii* Boud., Bull. Soc. Mycol. France 16: 102. 1900.

Gymnopus biformis (Peck) Halling, comb. nov.
Basionym: *Marasmius biformis* Peck, Bull. New York St. Mus. 67: 25. 1903.

Gymnopus brassicolens (Romagn.) Antonín & Noordel., comb. nov.
Basionym: *Marasmius brassicolens* Romagn., Bull. Soc. Mycol. France 68: 139. 1952.

Gymnopus confluens (Pers.:Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Agaricus confluens* Pers., Observ. Mycol. 8: 1796.

Gymnopus contrarius (Peck) Halling, comb. nov.
Basionym: *Marasmius contrarius* Peck, Bull. New York St. Mus. 150: 34. 1911.

Gymnopus dichrous (Berk. & Curt.) Halling, comb. nov.
Basionym: *Marasmius dichrous* Berk. & Curt., Ann. Mag. Nat. Hist. II, 12: 426. 1853.

Gymnopus dysodes (Halling) Halling, comb. nov.
Basionym: *Collybia dysodes* Halling, Mycologia Mem. 8: 79. 1983.

Gymnopus erythropus (Pers.:Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Agaricus erythropus* Pers., Syn. Meth. Fung. 367. 1801.

Gymnopus fagiphilus (Velen.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Collybia fagiphila* Velen., Novit. Mycol. 82: 1939.

Gymnopus fasciatus (Pennington) Halling, comb. nov.
Basionym: *Marasmius fasciatus* Pennington, N. Amer. Fl. 9: 270. 1915, a nom. nov. for *Marasmius anomalus* Peck, Ann. Rept. New York St. Mus. 24: 76. 1872, non *M. anomolus* Lasch ex Rabenhorst.

Gymnopus fuscopurpureus (Pers.:Fr.) Antonín, Halling, & Noordel. comb. nov.
Basionym: *Agaricus fuscopurpureus* Pers., Icon. Descr. Fung. 12. 1798.

Gymnopus graveolens (G. Poirault ex Boud.) Antonín & Noordel., comb. nov.
Basionym: *Collybia graveolens* G. Poirault ex Boud. Icones Mycol. 4: 33. 1905-1910.

Gymnopus hariolorum (Bull.:Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Agaricus hariolorum* Bull., Herb. France 1: pl. 58. 1781-1782.

Gymnopus hybridus (Kühner & Romagn.) Antonín & Noordel., comb. nov.
Basionym: *Marasmius hybridus* Kühner & Romagn., in Romagnesi, Bull. Soc. Mycol. France 68: 140. 1952.

Gymnopus impudicus (Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Marasmius impudicus* Fr., Epicr. Syst. Mycol. 377. 1838.

Gymnopus inodorus (Pat.) Antonín & Noordel., comb. nov.
Basionym: *Marasmius inodorus* Pat., Tab. Anal. Fung. pl. 523. (1886) 1887.

Gymnopus iocephalus (Berk. & Curt.) Halling, comb. nov.
Basionym: *Agaricus iocephalus* Berk. & Curt., Ann. Mag. Nat. Hist. II, 12: 420. 1853.

Gymnopus kauffmanii (Halling) Halling, comb. nov.
Basionym: *Collybia kauffmanii* Halling, Mycologia Mem. 8: 54. 1983, a nom. nov. for *Collybia hariolorum* var. *inodora* Kauffman & A. H. Smith, Pap. Michigan Acad. Sci. 17: 157. 1933, non *Gymnopus inodorus* (see above).

Gymnopus loiseleurietorum (Moser, Gerholt, & Tobies) Antonín & Noordel., comb. nov.
Basionym: *Collybia loiseleurietorum* Moser, Gerholt, & Tobies, in Moser & Rameseder, Biblioth. Mycol. 150: 171. 1993.

Gymnopus nivalis (Luthi & Plomb) Antonín & Noordel., comb. nov.
Basionym: *Marasmius nivalis* Luthi & Plomb, Bull. Soc. Mycol. France 83: 740. 1967.

Gymnopus ocior (Pers.)Antonín & Noordel., comb. nov.
Basionym: *Agaricus ocior* Pers., Mycol. Eur. 151. 1828.

Gymnopus oreadoides (Pass.) Antonín & Noordel., comb. nov.
Basionym: *Marasmius oreadoides* Pass., Nuovo Giorn. Bot. Ital. 4: 109. 1872.

Gymnopus peronatus (Bolt.:Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Agaricus peronatus* Bolt., Hist. Fung. Halifax 2: pl. 58. 1788.

Gymnopus polyphyllus (Peck) Halling, comb. nov.
Basionym: *Marasmius polyphyllus* Peck, Ann. Rept. New York St. Mus. 51: 286. 1898.

Gymnopus putillus (Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Agaricus putillus* Fr., Syst. Mycol. 1: 129. 1821.

Gymnopus semihirtipes (Peck) Halling, comb. nov.
Basionym: *Marasmius semihirtipes* Peck, Bull. Buffalo Soc. Nat. Sci. 1: 575. 1874

Gymnopus spongiosus (Berk. & Curt). Halling, comb. nov.
Basionym: *Marasmius spongiosus* Berk. & Curt., Hooker's J. Bot. Kew Gard. Misc. 1: 100. 1849.

Gymnopus striatipes (Peck) Halling, comb. nov.
Basionym: *Marasmius striatipes* Peck, Ann. Rept. New York St. Mus. 24: 76. 1872.

Gymnopus subnudus (Ellis ex Peck) Halling, comb. nov.
Basionym: *Marasmius subnudus* Ellis ex Peck, Ann. Rept. New York St. Mus. 51: 287. 1898.

Gymnopus subterginus (Halling) Halling, comb. nov.
Basionym: *Collybia subtergina* Halling, Mycologia Mem. 8: 90. 1983.

Gymnopus terginus (Fr.:Fr.) Antonín & Noordel., comb. nov.
Basionym: *Agaricus terginus* Fr.:Fr., Syst. Mycol. 1: 128. 1821.

Rhodocollybia butyracea f. *asema* (Fr.:Fr.) Antonín, Halling, & Noordel., comb. et stat. nov.
Basionym: *Agaricus butyraceus* [var.] *asemus* Fr., Observ. Mycol. 2: 124. 1818.

Rhodocollybia fodiens (Kalchbr.) Antonín & Noordel., comb. nov.
Basionym: *Agaricus fodiens* Kalchbr., Icon. Select. Hymenomyc. Hung. 4: 62. 1877.

Rhodocollybia lentinoides (Peck) Halling, comb. nov.
Basionym: *Agaricus lentinoides* Peck, Ann. Rept. New York St. Mus. 32: 27. 1879 (1880).

Rhodocollybia meridana (Dennis) Halling, comb. nov.
Basionym: *Collybia meridana* Dennis, Kew Bull. 15: 72. 1961.

Rhodocollybia popayanica (Halling) Halling, comb. nov.
Basionym: *Collybia popayanica* Halling, Mycologia 81: 872. 1989 (1990).

Rhodocollybia prolixa (Hornem.:Fr.) Antonín & Noordel., comb. nov.
Basionym: *Agaricus prolixus* Hornem. Fl. Dan. 9(27): pl. 1608. 1818.

Rhodocollybia prolixa var. *distorta* (Fr.) Antonín, Halling, & Noordel., comb. et stat. nov.
Basionym: *Agaricus distortus* Fr., Epicr. Syst. Mycol. 84. 1838.

Rhodocollybia sleumeri (Singer) Halling, comb. nov.
Basionym: *Collybia sleumeri* Singer, Rev. Mycol. (Paris) 18: 4. 1953.

Rhodocollybia turpis (Halling) Halling, comb. nov.
Basionym: *Collybia turpis* Halling, Mycologia 81: 870. 1989 (1990).

Rhodocollybia unakensis (Murrill) Halling, comb. nov.
Basionym: *Gymnopus unakensis* Murrill, N. Amer. Fl. 9: 366. 1916.

Marasmiellus perforans (Hoffm.:Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Agaricus perforans* Hoffm., Nomencl. Fung. 1: 215, pl. 4, fig. 2. 1789.

Marasmiellus foetidus (Sowerby:Fr.) Antonín, Halling, & Noordel., comb. nov.
Basionym: *Merulius foetidus* Sowerby, Col. Figs. Engl. Fungi 1: 15. 1796.

Previously accepted and recognized taxa. We include in the following list, valid binomials of taxa in *Gymnopus* and *Rhodocollybia* that are currently known and recognized by at least one of us.

Gymnopus acervatus (Fr.) Murrill, N. Amer. Fl. 9: 362. 1916.

Gymnopus dryophilus (Bull.:Fr.) Murrill, N. Amer. Fl. 9: 362. 1916.

Gymnopus earleae Murrill, N. Amer. Fl. 9: 364. 1916.

Gymnopus fusipes (Bull.:Fr.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 604. 1821.

Gymnopus luxurians (Pk.) Murrill, N. Amer. Fl. 9: 362. 1916.

Gymnopus macropus Halling, Brittonia 48: 490. 1996 (1997).

Gymnopus mucubajiensis (Dennis) Halling, Brittonia 48: 488. 1996 (1997).

Gymnopus nubicola Halling, Brittonia 48: 492. 1996 (1997).

Gymnopus spongiosus (Berk. & Curt.) Halling, Brittonia 48: 489. 1996 (1997).

Gymnopus subsulphureus (Pk.) Murrill, N. Amer. Fl. 9: 359. 1916.

Rhodocollybia badiialba (Murrill) Lennox, Mycotaxon 9: 224. 1979.

Rhodocollybia butyracea (Bull.:Fr.) Lennox, Mycotaxon 9: 219. 1979.

Rhodocollybia filamentosa (Velen.) Antonín, Acta. Mus. Moraviae, Sci. Nat. 71: 91. 1986.

Rhodocollybia maculata (Fr.) Singer, Schweiz. Zeit. Pilzk. 17: 71. 1939.

Rhodocollybia maculata var. *scorzonerea* (Fr.) Lennox, Mycotaxon 9: 214. 1979.

Rhodocollybia oregonensis (A. H. Smith) Lennox, Mycotaxon 9: 202. 1979.

Rhodocollybia subsulcatipes (A. H. Smith) Lennox, Mycotaxon 9: 201. 1979.

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Literature Cited

Antonín, V. & M. E. Noordeloos. 1993. A monograph of *Marasmiellus*, *Collybia*, and related genera in Europe. Part 1: *Marasmius*, *Setulipes*, and *Marasmiellus*. Libri Botanici 8: 1-229.

_____, & _____. 1997. A monograph of *Marasmiellus*, *Collybia*, and related genera in Europe. Part 2. Libri Botanici (in prep.).

Dennis, R. W. G., P. D. Orton, & F. Hora. 1960. New checklist of British agarics and boleti. Trans. Brit. Mycol. Soc. 43: (suppl.).

Earle, F. S. 1909. The genera of North American gill fungi. Bul. New York Bot. Gard. 5: 1-320.

Gray, S. F. 1821. A natural arrangment of British plants. Vol. 1. London. 824 p.

Halling, R. E. 1983. The genus *Collybia* (Agaricales) in the northeastern United States and adjacent Canada. Mycologia Mem. 8: 1-148.

_____. 1989 (1990). Notes on *Collybia*. III. Three Neotropical species of subgenus *Rhodocollybia*. Mycologia 81: 870-875.

_____. 1994. An alternative concept of *Collybia* (Agaricales). IMC-5. Abstracts, p. 80.

Honrubia, M. 1984. *Micromphale* (*Collybiopsis*) *trabutii* (Maire) Honrubia nov. comb., in Spain. New Marasmiaceae Roze family names. Cryptogamie (Mycol.) 5: 51-58.

Horak, E. 1968. Synopsis generum Agaricalium (Die Gattungstypen der Agaricales). Beitr. Krypt.-Fl. Schweiz 13: 1-741.

_____. 1971. A contribution towards the revision of the Agaricales (Fungi) of New Zealand. New Zealand J. Bot. 9: 403-462.

Jansen, A. E. 1991. Het geslacht *Collybia*. Wetensch. Mede. 205: 1-64.

Jülich, W. 1981. Higher taxa of Basidiomycetes. Biblioth. Mycol. 85: 1-485.

Kühner, R. 1933. Etudes sur le genre *Marasmius*. Botaniste 25: 57-116.

_____. 1935 (1936). Nouvelles recherches sur le genre *Marasmius*. Ann. Soc. Linn. Lyon 79: 99-120.

_____. 1980. Les hyménomycetes agaricoides (Agaricales, Tricholomatales, Pluteales, Russulales). Bull. Soc. Linn. Lyon 49 (num. spéc.): 1-1027.

_____, and H. Romagnesi. 1953. Flore analytique des champignons supérieurs. Masson et Cie, Paris. 556 p.

Lennox, J. W. 1979. Collybioid genera in the Pacific Northwest. Mycotaxon 9: 244-276.

Murrill, W. A. 1915. 16. *Marasmiellus*. N. Amer. Fl. 9: 243-244.

_____. 1916. 30. *Micromphale*. N. Amer. Fl. 9: 297-374.

Redhead, S. A. 1987. The Xerulaceae (Basidiomycetes), a family with sarcodimitic tissues. Canad. J. Bot. 65: 1551-1562.

Singer, R. 1948. Diagnoses fungorum novorum agaricalium. Sydowia 2: 26-42.

_____. 1949 (1951). The Agaricales (Mushrooms) in modern taxonomy. Lilloa 22: 1-832.

_____. 1973. The genera *Marasmiellus*, *Crepidotus*, and *Simocybe* in the Neotropics. Beih. Nova Hedwigia 44: 1-339.

_____. 1986. The Agaricales in modern taxonomy. Ed. 4. Koenigstein. 981 p.

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NEW OR RARE HYPHOMYCETES FROM CUBA VIII. SPECIES OF *LYLEA*, *PHAEOISARIA*, *ARXIELLA*, *GRAPHIUM*, *PERICONIA* AND *RAMICHLORIDIUM*.

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ABSTRACT

A new species of ***Lylea*** and a new variety of ***Phaeoisaria sparsa*** are described and illustrated. These fungi were collected in the Havana Metropolitan Park, Cuba. Four uncommon species collected on plant debris in Havana City are reported for the first time for this country: ***Arxiella terrestris***, ***Graphium putredinis***, ***Periconia jabalpurensis*** and ***Ramichloridium apiculatum***. A dichotomous key to ***Lylea*** species is provided.

Keywords: Hyphomycetes, ***Lylea***, ***Phaeoisaria***, Cuba.

RESUMEN

Se describe e ilustra una nueva especie del género ***Lylea*** y una nueva variedad de ***Phaeoisaria sparsa***, recolectadas en el Parque Metropolitano de la Habana, Cuba. También se registran, por vez primera para el país, cuatro especies poco comunes recolectadas sobre restos vegetales en Ciudad de la Habana, que son: ***Arxiella terrestris***, ***Graphium putredinis***, ***Periconia jabalpurensis*** y ***Ramichloridium apiculatum***. Se aporta una clave dicotómica para las especies de ***Lylea***.

Palabras clave: Hiphomycetes, ***Lylea***, ***Phaeoisaria***, Cuba.

INTRODUCTION

The present work continues the taxonomic study of Cuban hyphomycetes with the description of a new species and a new variety in the genera ***Lylea*** Morgan-Jones and ***Phaeoisaria*** Höhnel respectively. Furthermore four other species belonging to the genera ***Arxiella*** Papendorf, ***Graphium*** Corda, ***Periconia*** Tode ex Fries and **Ramichloridium** Stahel ex de Hoog are new records for Cuban mycobiota. The samples were collected mostly during 1993 in the Metropolitan Park and at the "La Chata" farm in Havana city. The specimens examined, including types, are deposited at the Mycological Herbarium of the Academy of Sciences of Cuba (HACM).

TAXONOMY

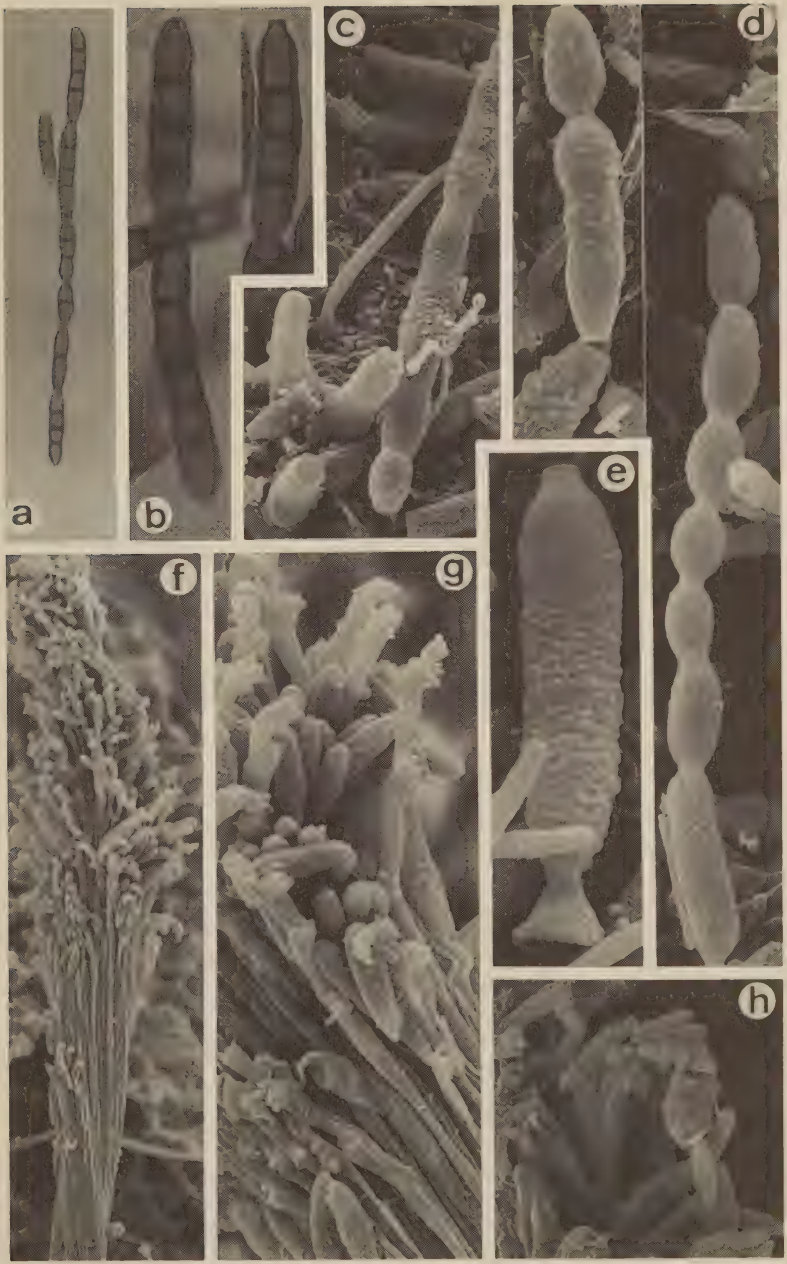
Lylea palmicola Mercado, Figueras et Gené **sp. nov**. (Figs.1a-e, 2c)

Coloniae effusae, velutinae vel flocculosae, pallide brunneae vel brunneae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis pallide brunneis, septatis, ramosis, laevis, 2-3 μm lat. Conidiophora micronematosa vel semi-macronematosa, brevia, cylindrica, ex hyphis prodientia, erecta, non ramosa, pallide brunnea, septata, laevia, 4-8 x 3.0-3.5 μm. Cellulae conidiogenae monoblasticae, integratae, terminales vel supra conidia intercalares et ergo in catenas acropetas conidiorum concatenatae; catenae breves vel longae, plerumque non ramosae sed interdum ramosae, mox deciduae. Conidia cylindrica, ellipsoidea vel fusiformia, utrinque truncata, brunnea vel aureo-brunnea, 0-4 (3) pseudoseptata, laevia vel verruculosa, septis crassis, saepe per constrictiones unita, 6-18 x 2.5-4.0 μm.
Holotypus: HACM 7393, ex supra rhachim emortuam palmae, Parque Metropolitano de La Habana, La Habana, Cuba, leg. A. Mercado et J. Mena, 26.III.1985.

Colonies effuse, velvety or floccose, pale brown to brown. Mycelium partly superficial and partly immersed in the substratum, hyphae branched, septate, pale brown, smooth, 2-3 μm wide. Conidiophores micro or semi-macronematous, arising as short and cylindrical branches on hyphae, erect or ascending, unbranched, pale brown, septate, smooth, 4-8 x 3.0-3.5 μm. Conidiogenous cells monoblastic, integrated and terminal on the conidiophores. Conidia formed mostly in simple acropetal chains, which often separate readily, cylindrical, ellipsoidal or fusiform with truncate ends, mid to golden brown, with 0-4 (3) pseudosepta, thick-walled, smooth to verruculose (wrinkled under SEM), 6-18 x 2.5-4.0 μm.
Other material examined: HACM 9112, on dead rachis of Arecaceae, Parque Metropolitano de La Habana, Cuba, leg. A. Mercado and J. Mena, 23 Oct.1993.

Lylea species are saprophytic, found on bark and rotten wood or growing on rotten fructifications of some pyrenomycetes. ***Lylea*** is separated from other closely related genera such as ***Heteroconium*** Petrak and ***Septonema*** Corda, because these possess long macronematous conidiophores and conidia with true septa. Another related genus is ***Taeniolella*** S.J. Hughes, but its conidia are delimited by true septa, seceding only with difficulty, and the constrictions between conidia, commonly seen in ***Lylea***, are not present.

Fig. 1. a-e. ***Lylea palmicola***. HACM 7393; a-e. Conidiogenous cells and conidia, a. x512; b. x1280; c. x1500; d. x2500; e.x3700. f-h. ***Phaeoisaria sparsa*** var. ***cubensis***, HACM 9113; f. Synnemata; g,h. Detail of polyblastic conidiogenous cells and conidia. f. x450; g. x1600; h. x1200.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The new species here described is separated from the other two known species, ***L. catenulata*** Morgan-Jones (1975) and ***L. tetracoilum*** (Corda) Holubová-Jechová (1978), by possessing smaller conidia with 0-4 pseudosepta. ***L. catenulata*** possesses 4-7 pseudoseptate conidia measuring 40-67 x 7-9 µm, while in ***L. tetracoilum*** they are 20-50 x 4.0-5.5 µm, with 2-4 pseudosepta. Furthermore, in the latter species the conidiophores are longer (25-65 µm), while in ***L. palmicola*** they are almost micronematous (4-8 x 3.0-3.5 µm).

This taxon was recently collected in Mexico too. The Mexican specimen is similar to the Cuban ones. The species has been collected always on palm and its colonies were closely associated with others of ***Helminthosporium foveolatum*** Patouillard.

KEY TO ***LYLEA*** SPECIES

1a.- Conidia with more than 4 pseudosepta and more than 7 µm wide .... ***L. catenulata***
1b.- Conidia usually 0-4 pseudoseptate and narrower 2

2a.- Conidia 20-50 x 4.0-5.5 µm, 2-4 pseudoseptate. Conidiophores macronematous, 25-65 µm long .... ***L. tetracoilum***
2b.- Conidia 6-18 x 2.5-4.0 µm, 0-4(3) pseudoseptate. Conidiophores micronematous, 4-8 µm long .... ***L. palmicola***

Phaeoisaria sparsa Sutton var. ***cubensis*** Mercado, Figueras et Gené **var. nov.**
(Figs.1 f-h, 2 a-b)

A typus differt conidiis minoribus, et ramulis synnematis pallide brunneis vel olivaceus.
Holotypus: HACM 9113, ex ramis mortuis. Parque Metropolitano de La Habana, La Habana, Cuba, leg. A. Mercado et J. Mena. 23.X.1993.

Colonies effuse, olivaceous or pale brown. Synnemata erect, pale brown to pale olivaceous brown, conidiophores branched and splaying out at the apex, 100-275 x 30-90 µm at the base, 25-60 µm wide immediately above the base and 18-40 µm toward the apex. Individual hyphae pale olivaceous brown and 2.0-2.5 µm wide. Symematal branches hyaline or subhyaline, septate, 10-25 x 2.5-3.5 µm. Conidiogenous cells polyblastic, integrated, sometimes sympodial, subulate, with numerous denticles (1.0-1.5 µm long). Conidia solitary, dry, acropleurogenous, fusiform, cylindrical or clavate, sometimes slightly curved, hyaline, smooth, mostly 0-1 septate, rarely some conidia 4-septate; (4-) 7-11 (-17) x (1.5-) 2-3 (-4) µm.

The genus ***Phaeoisaria*** is characterized by possessing, erect and well developed synnemata on the natural substrate from which arise numerous branches bearing denticulate conidiogenous cells in the apical region. Hoog and Papendorf (1976) provide a monograph and a key of this genus. Most of the

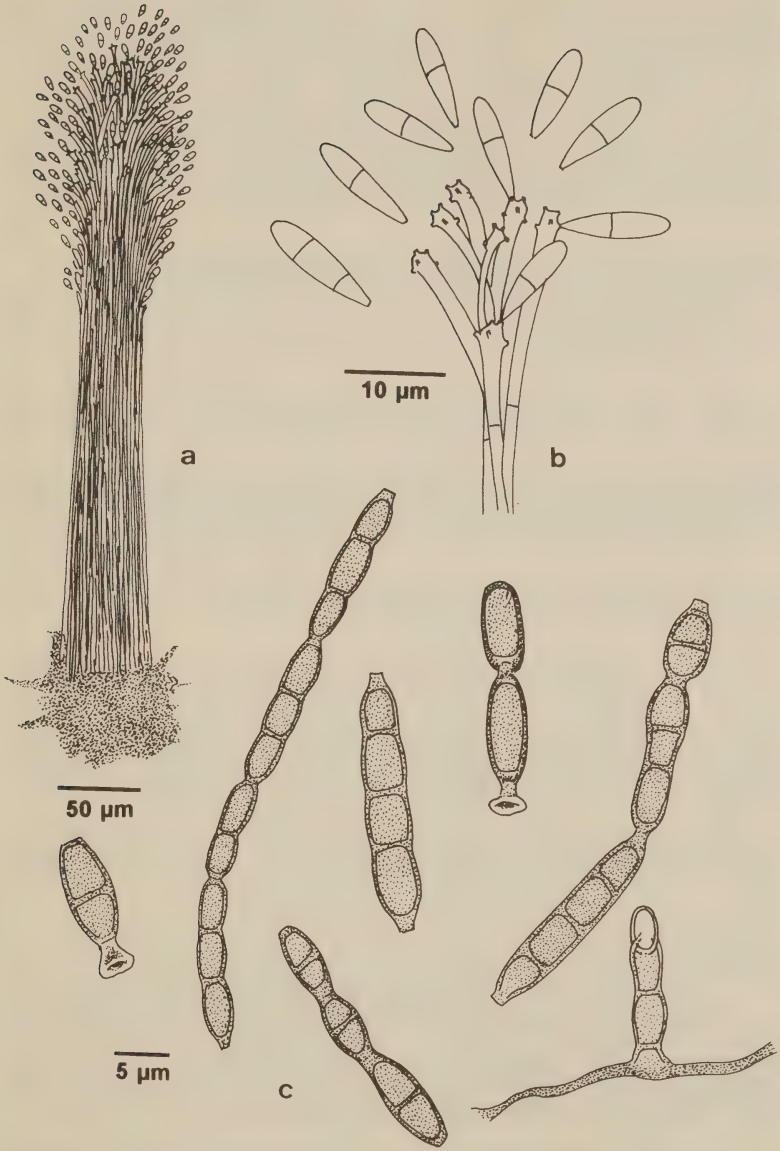

Fig. 2. a,b. ***Phaeoisaria sparsa*** var. ***cubensis***, HACM 9113; a. Synnemata; b. Detail of conidiogenous cells and conidia; c. ***Lylea palmicola***, HACM 7393. Conidial chains, conidia and conidiogenous cells.

species including the type species ***P. clematidis*** (Ferl.) S.J. Hughes have continuous and hyaline conidia, only a few species possessing one to three transverse septa (Sutton, 1973; Mercado, 1984; Holubová-Jechová, 1988). ***P. sparsa*** var. ***sparsa***, collected previously from plant debries (Sutton, 1973; Hughes, 1978), closely resembles the var. ***cubensis*** on the basis of size and general configuration of synnemata and conidial shape and septation. However, in the Cuban specimen, the colour of the synnematal branches is paler and the conidia are more variable in size and usually smaller than those of the var. ***sparsa***, on which grounds we propose this new variety of ***P. sparsa***.

CONIDIAL FUNGI FIRST RECORDED FOR CUBA

Arxiella terrestris Papendorf, Trans. Br. Mycol. Soc., 50: 73 (1967).

Colonies growing slowly on PDA. Mycelium composed of hyaline or subhyaline, 1.5-4.0 mm wide hyphae. Conidiophores micronematous. Conidia hyaline, mostly with one transverse septum or sometimes continuous, 8-16 x 2.5-3.5 µm.
Material examined: HACM 9114, on dead stems of *Cissus sicyoides* L, "La Chata", Capdevila, Boyeros, La Habana, Cuba, leg. A. Mercado, 4 Oct.1993.

This species is relatively common in tropical and subtropical areas.

Graphium putredinis (Corda) S.J. Hughes, Can. J. Bot., 36: 770 (1958).
Syn: ***Stysanus putredinis*** Corda, Icon. Fung., 3: 12 (1839).

Synnemata olivaceous brown to brown, paler towards the apex, 400-750 x 25-40 µm. Conidiophore hyphae 1.5-2.0 µm wide. Conidia ellipsoidal to cuneiform, subhyaline or olivaceous, smooth, 4-10 x 1.5-3.5 µm.
Material examined: HACM 9115, on dead sheath of an undetermined leguminous tree, "La Chata", Capdevila, Boyeros, La Habana, Cuba, leg. A. Mercado, 4 Oct.1993.

This taxon is frequently reported on dead herbaceous stems, particularly common on *Brassica* spp. and also isolated from soil in temperate Europe (Ellis, 1971).

Periconia jabalpurensis Tiwari et Agrawal, Curr. Sci., 41: 462-463 (1972).

Conidiophores dark brown, 500-950 x 8-18 µm, toward the apex up to 25 µm wide. Conidia spherical, brown, minutely echinulate, arising from apical discrete conidiogenous cells, 8.0-11.5 µm wide.
Material examined: HACM 9116, on dead branches of *Bambusa vulgaris*, "La Chata", Capdevila, Boyeros, La Habana, Cuba, leg. A. Mercado and J. Mena, 21 Oct.1993.

This ***Periconia*** species presents some similarities with ***P. byssoides*** Pers. ex Mérat, though conidia are smaller. It was collected previously from soil in India (Ellis, 1976) and this is the first record of the species for the Western Hemisphere.

Ramichloridium apiculatum (Miller, Giddens et Foster) de Hoog, CBS Studies in Mycology 15: 59 (1977).
Syn: ***Chloridium apiculatum*** Miller, Giddens et Foster, Mycologia 49:789 (1958); ***Veronaea apiculata*** (Miller, Giddens & Foster) M.B. Ellis (1976).

Conidiophores with numerous small scars, 50-75 x 2-3 μm. Conidia ellipsoidal or obovoid, pale brown, minutely verrucose, 3.5-6.5 x 2-3 μm.

Material examined: HACM 9117, on inflorescence of *Cissus sicyoides* L., "La Chata", Capdevila, Boyeros, La Habana, Cuba, leg. A. Mercado and J. Mena, 4 Oct.1993.

The species was originally described within the phialidic genus ***Chloridium*** Link ex Fries. Ellis (1976) recombined it as ***Veronaea apiculata***. Hoog and Hermanides-Nijhof (1977) later erected the genus ***Ramichloridium*** typified by ***R. musae*** Stahel ex M.B. Ellis and included the present species in this genus.

ACKNOWLEDGEMENTS

We are grateful to Dr. Pedro Herrera (Instituto de Ecología y Sistemática, La Habana, Cuba) for correcting the latin diagnoses and to Dr. Enrique Descals (IMEDEA, CSIC-UIB) for revision of the manuscript. This study was partly supported by "Fundació Ciència i Salut".

REFERENCES

Ellis, M.B. (1971). Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew, Surrey, 608 pp.

Ellis, M.B. (1976). More Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew, Surrey, 507 pp.

Holubová-Jechová, V. (1978). Lignicolous Hyphomycetes from Czechoslovakia 5. ***Septonema, Hormiactella,*** and ***Lylea***. Folia Geobot. Phytotax., 13: 421-442.

Holubová-Jechová, V. (1988). Studies on Hyphomycetes from Cuba VII. Seven new taxa of dematiaceous Hyphomycetes. Cês. Mykol. 42: 23-30.

Hoog de, G.S. y M.C. Papendorf (1976). The genus ***Phaeoisaria***. Persoonia 8(4): 407-414.

Hoog de, G.S. y E.J. Hermanides-Nijhof (1977): Survey of the black yeasts and allied fungi. Stud. Mycol. 15: 178-221.

Hughes, S.J. (1978). New Zealand Fungi 25. Miscellaneous species. New Zealand J. Bot. 16: 311-370.

Mercado Sierra, A. (1984). Nuevas especies de ***Deightoniella, Phaeoisaria, Sporidesmium*** y ***Taeniolella*** (Hyphomycetes) de Cuba. Act. Bot. Cubana 21: 1-10.

Morgan-Jones, G. (1975). Notes on Hyphomycetes VIII. ***Lylea***, a new genus. Mycotaxon 3: 129-132.

Sutton, B.C. (1973). Hyphomycetes from Manitoba and Saskatchewan, Canada. Mycol. Pap. 132: 1-143.

MYCOTAXON

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TWO NEW BLUING SPECIES OF *PSILOCYBE* FROM PUERTO RICO

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ABSTRACT

Psilocybe guilartensis (Sect. *Brunneocystidiatae*) and *P. portoricensis* (Sect. *Cordisporae*) are described as new species from the central mountain region of Puerto Rico. Previously only *P. cubensis* and *P. subcubensis* were known from the island. The new species are from similar subtropical humid mountainous zone covered by a mesophytic forest, where most hallucinogenic species of *Psilocybe* are distributed in tropical America.

INTRODUCTION

The enormous diversity of the fungi in the world makes completion of generic monographs difficult. The genus *Psilocybe* (Fr.) P. Kumm., so extensively studied in the world due to the association with psychotropic action, was monographed by Guzmán (1983) and 144 species were considered. Recently, Guzmán (1995) published a supplement to the monograph, in which he critically discussed another 29 species, and also 5 new species were described. However, revising some collections of *Psilocybe* gathered from Puerto Rico, the authors found two new species that are herein described. The only *Psilocybe* species previously known from Puerto Rico were the common tropical *P. cubensis* (Earle) Singer and *P. subcubensis* Guzmán, reported by Seaver & Chardon (1926) and Stevenson (1975) the first, and by Navarro & Betancourt (1992) both. To study the material, microscopical observations were made from slides mounted in 5 % KOH, Melzer's reagent or cotton-blue in lactophenol.

Localities explored in Puerto Rico for the two described species, are located in the central mountain zone (Cordillera Central) of the island, on the Caribbean side. Mean annual precipitation ranges from 2000 to 4000 mm, with a mean annual temperature of 19-25 °C. They are covered by a mesophytic forest, with *Cyathea* Kaulf., *Dacryodes* Vahl., *Euterpe* Gaertn, *Guarea* Allem. ex L., *Inga* Scop. and *Terminalia* L., among others, and coffee plantations (Birdsey & Jiménez, 1985; Ewel & Whitmore, 1973). This zone is part of the subtropical humid mountainous region of Latin America, considered by Guzmán (1983, 1995), the richest in hallucinogenic species of *Psilocybe*, which extends from the Yungas region (N of Argentina) to the mountains of Venezuela and Colombia at 1000-2000 m elevation through the Andes, reaching the central mountains of Mexico at 900-2000 m elevation. *Alnus* (Tourn.) L. is a common tree in this region, while *Quercus* (Tourn.) L. is only known from Colombia to Mexico and in various Caribbean islands. *Liquidambar* L., *Clethra* Gronov. ex L., *Carpinus* L., *Platanus* (Tourn.) L., *Cyathea* and coffee plantations are common in Mexican mesophytic forests. The Lesser Antilles localities at 500-1000 m elevation, where Pegler (1983) collected *P. plutonia* (Berk. & M.A. Curtis) Sacc., *P. caerulescens* Murrill and *P. yungensis* Singer, are also included in this subtropical region (Guzmán, 1986).

DESCRIPTION OF THE NEW SPECIES

Psilocybe guilartensis Guzmán, Tapia & Nieves-Rivera, sp. nov. Figs. 1-8

Pileus 10-20 (-30) mm latus, conicus vel campanulatus, vel acute papillatus, papilla ad 3 mm longa, laevis, subviscidus, hygrophanus, rufobrunneus vel brunneolus aut fulvus, subcaeruleus. Lamellae adnexae, brunneo-lilaceae. Stipes 50-65 (-80) x 1-1.5 mm, cylindricus, flexuosus, rufobrunneus, subcaeruleus. Sporae (5-) 5.5-6.5 x 5-5.5 x 4-5 μm, subrhomboideae vel subglobosae, tunica crassa, dilute fulvae. Basidia 21.5-32 x 5.5-7 μm, tetraspora. Pleurocystidia (16-) 18.5-25.5 x (7-) 8-9.5 (-10.5) μm, copiosa, dilute fulva vel brunneola, subfusoideus vel ventricosus, irregularis ramosus. Cheilocystidia 20-24 x (7-) 8-10 μm, ventricosus, subfusoides vel sublageniformis, similia cystidiis facie lamellarum colore. Epicutis gelatinosus. Fibulae adsum. Ad terram in silvis subtropicalibus. Puerto Rico, prope Adjuntas, Guilarte State Forest, Nieves-Rivera et al. s.n. holotypus Herb. MAPR; isotypus Herb. XAL.

Pileus 10-20 (-30) mm diam, conic to campanulate, with an acute and elongate papilla (up to 3 mm), glabrous, smooth, translucent striate at the margin, subviscid, hygrophanous, reddish brown to brownish or tawny brown, bluing. Lamellae adnexed, dark violaceous brown, with concolorous edges. Stipe 50-65 (-80) x 1-1.5 mm, uniform, but slightly thickened at the base, flexuous, brownish red to somewhat blackish, bluing, irregularly covered with white minutely floccose fibrils, hollow. Veil absent at maturity. Context brownish, bluing. Spores (5-) 5.5-6.5 x 5-5.5 x 4-5 μm, subrhomboid or subglobose in face-view, subellipsoid in side-view, thick-walled, wall up to 1 μm thick, pale yellowish brown, with a broad plane and apical pore, and with a short basal appendage. Basidia 21.5-32 x 5.5-7 μm, 4-spored, subcylindric, medially subconstricted, hyaline. Pleurocystidia (16-) 18.5-25.5 x (7-) 8-9.5 (-10.5)

μm, abundant, light melleous, greyish brown or dark brownish, fusoid, subfusoid or vesiculose, at times with a short, thick, obtuse neck, sometimes irregularly branched and others capitate. Cheilocystidia 20-24 x (7-) 8-10 μm, vesiculose, subfusoid or sublageniform with a short tapering apex, as the pleurocystidia in color. Subhymenium scarcely differentiated, formed by hyaline to yellowish, thin-walled elements, 2.5-4 μm in diam, with incrusted, brownish pigment. Hymenophoral trama regular, with hyaline to yellowish hyphae, 2.5-9 μm diam, and inflated hyphae up to 16 μm diam, both thick-walled, walls up to 2 μm thick, with yellowish incrustations. Epicutis as a thin gelatinized layer of hyaline to yellowish pale hyphae, 1.5-3 μm diam. Hypodermium formed by hyaline to yellowish pale hyphae, 3.5-8 μm diam, thin walled, frequently with incrusted brownish pigment. Context with hyaline to yellowish hyphae, 4-8 μm diam with inflated elements up to 28 μm diam, thick-walled, walls up to 1.5 μm thick, with incrusted brownish pigment. Clamp-connections present.

Habitat and distribution. Gregarious or solitary on muddy clay brownish soil, along a trail, in a coffee plantation in a mesophytic forest. Known only from Puerto Rico.

Studied material. PUERTO RICO, Municipio Adjuntas, Guilarte State Forest, trail to Pico Monte Guilarte (18°07N, 66°47´W), 900 m alt., Sept. 1994, *Nieves-Rivera, Santos-Flores & Betancourt* s.n. (holotype MAPR; isotype XAL). Municipio Villalba, Toro Negro State Forest, trail to Torre 3 (18°10´N,66°30´W), 820-1015 m alt., Oct. 1994, *Nieves-Rivera, Santos-Flores & Betancourt s.n.* (MAPR; NY as *Psilocybe plutonia*).

Discussion. This species belongs to Sect. *Brunneocystidiatae* Guzmán by virtue of the color of the cystidia. It is close to *P. pleurocystidiosa* Guzmán from Mexico for the form, color and size of the pleurocystidia, and ecological distribution, but the cheilocystidia are 16-21 x 5-6 μm and the pileus is not papillated (Guzmán, 1983).

Psilocybe portoricensis Guzmán, Nieves-Rivera & Tapia sp. nov. Figs. 9-12

Pileus 5-15 (-20) mm latus, campanulatus vel subpapillatus, subviscidus, laevis, hygrophanus, luteus fuscus vel coffeatus, subcaeruleus. Lamellae adnexae, brunneo-lilaceae. Stipes 45-50 (-60) x 0.5-1 mm, cylindricus, flexuosus, subfuscus vel rufobrunneus, subcaeruleus. Sporae 5-5.5 x 4-5 x 3-4 μm, subrhomboideae vel subglobosae, tunica crassa, dilute fulvae. Basidia 20-32 x 5-7 μm, tetraspora. Pleurocystidia 13.5-20 x 5-7 μm, frecuentes, hyalina, sublageniformis. Cheilocystidia 16-24 x 5-7 μm, hyalina, sublageniformis vel ramosa. Epicutis gelatinascens. Fibulae adsum. Ad terram in silvis subtropicalibus. Puerto Rico, prope Villalba, Toro Negro State Forest, Nieves-Rivera et al. s.n. holotypus Herb. MAPR; isotypus Herb. XAL.

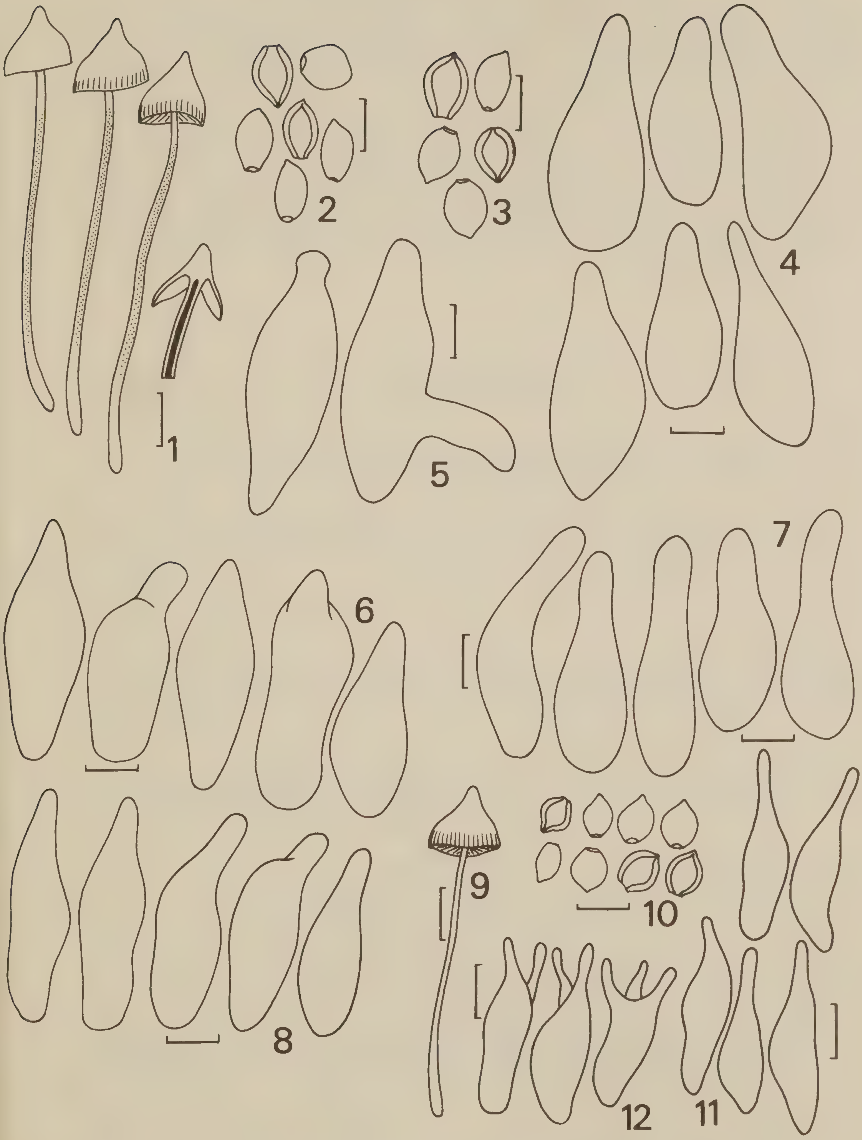
Pileus 5-15 (-20) mm diam, campanulate to subpapillate, glabrous, smooth but striate towards the margin, subviscid, hygrophanous, dark buff to coffee brown, bluing. Lamellae adnexed, dark violaceous brown, with concolorous edges. Stipe 45-50 (-60) x 0.5-1 mm, uniform, smooth, brownish to dark brownish red, hollow, bluing. Veil ephemeral. Context brownish, bluing. Spores 5-5.5 x 4-5 x 3-4 μm, subrhomboid or subglobose in face-view, subellipsoid and slightly inaequilateral in side-view, thick-walled, wall up to 1 μm thick, pale yellowish brown, with a distinct plane and apical pore, and with a short basal appendage. Basidia 20-32 x 5-7 μm, 4-spored, subcylindric to clavate, hyaline. Pleurocystidia 13.5-20 x 5-7 μm, more or less abundant, hyaline, sublageniform with a long tapering apex. Cheilocystidia 16-24 x 5-7 μm, hyaline, sublageniform, with two or three regular or irregular long necks. Subhymenium subcellular, poorly differentiated, with hyaline, subcylindrical or subglobose, thin-walled elements, 2.5-5.5 μm in diam. Hymenophoral trama regular, with hyaline to yellowish hyphae, 4-9 μm in diam, with inflated hyphae up to 28 μm diam, thin- to thick-walled (wall up to 2 μm thick), irregularly incrusted with yellowish pigment. Epicutis an irregular, thin, gelatinized layer of pale yellowish hyphae, 1.5-3 μm diam. Hypodermium with cylindric to subglobose elements, 2.5-9.5 μm diam, hyaline to yellowish, thin-walled and with incrusted yellowish pigment. Context with cylindric to subglobose elements, 4-10 μm diam, hyaline to yellowish, thin- to thick-walled, with irregular yellowish incrustations. Clamp-connections present.

Habitat and distribution. Gregarious or solitary on muddy clay brownish soil or humus in a coffee plantation, along a trail, in a mesophytic forest. Known only from Puerto Rico.

Studied material. PUERTO RICO, Municipio Villlalba, Toro Negro State Forest, trail to Torre 3 (18°10´N, 66°30´W), 820-1015 m alt., Oct. 1994, Nieves-Rivera, Santos-Flores & Betancourt s.n. (holotype MAPR; isotype XAL).

Discussion. This species belongs to Sect. *Cordisporae* Guzmán by virtue of their smaller rhomboid spores, bluing feature and subtropical habitat. It is close to *Psilocybe subtropicalis* Guzmán, from Mexico and Guatemala, by the branched cheilocystidia, but that species has spores (5.5-) 6.5-7 (-8) μm long and collybioid habit (Guzmán, 1995). *P. plutonia* differs with pleurocystidia broadly ventricose, ventricose-mucronate or obpyriform, 17-26 (-30) x 9-12 μm (Guzmán, 1983, 1995).

Figs. 1-12.- **Figs. 1-8**: *Psilocybe guilartensis*, **1**: basidiomata, **2-3**: spores, **4-6**: pleurocystidia (*5*: a rare form), **7-8**: cheilocystidia (1-2, 4-5, 7: holotype; 3, 6, 8: Nieves-Rivera *et al*. s.n. from Toro Negro). **Figs. 9-12**: *Psilocybe portoricensis*, **9**: basidioma, **10**: spores, **11**: pleurocystidia, **12**: cheilocystidia (all from the holotype). Scale bar 10 mm in *1 & 9*; 5 μm in *2, 4, 5 & 6*; 6 μm in *3*; and 7 μm in *7, 8, 10, 11 & 12*.



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REFERENCES

Birdsey, R.A. & D. Jiménez (1985). *The forests of Toro Negro*. U.S. Forest Service, Southern Forest Experimental Station, New Orleans, 29 pp.

Ewel, J.J. & J.L. Whitmore (1973). *The ecological life zones of Puerto Rico and the U.S. Virgin Islands*. U.S. Forest Service, Institute of Tropical Forestry, Río Piedras (Puerto Rico), 72 pp + 1 map.

Guzmán, G. (1983). *The genus Psilocybe*. Beihefte zur Nova Hedwigia **74**, 439 pp.

Guzmán, G. (1986). Distribución de los hongos en la región del Caribe. *Caldasia* **15**: 103-120.

Guzmán, G. (1995). Supplement to the monograph of the genus *Psilocybe*. *In*: O. Petrini, & E. Horak, *Taxonomic monographs of Agaricales*. Bibliotheca Mycologica **159**, pp. 91-141, Berlin-Stuttgart, Cramer.

Navarro, A. & C. Betancourt (1992). Hongos alucinógenos en el suroeste de Puerto Rico. *International Journal of Mycology and Lichenology* **5** (3): 175-194.

Pegler, D.N. (1983). *Agaric flora of the Lesser Antilles*. Kew Bulletin Additional Series IX, Her Majesty's Stationery Office, London, 668 pp. + 27 pls.

Seaver, F.J. & C.E. Chardon, 1926. Mycology. *In*: *Botany of Porto Rico and the Virgin Islands*. Scientific Survey of Porto Rico and the Virgin Islands 8(1), New York Academy of Sciences, New York, 208 pp.

Stevenson, J.A. (1975). *Fungi of Puerto Rico and the American Virgin Islands*. Contribution of Reed Herbarium 23 (Baltimore), Braun-Brumfield, Ann Arbor, 743 pp.

MYCOTAXON

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TRICHOLOMA ALBIDULUM sp. nov. (TRICHOLOMATACEAE, AGARICALES) FROM BAJA CALIFORNIA, MEXICO.

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SUMMARY: *Tricholoma albidulum*, a new species growing in woods dominated by *Pinus jeffreyi* in Baja California (Mexico), is described and illustrated.

Key words: *Tricholoma albidulum*, sect. *Polyphyllina*, *Agaricales s. l.*, *Pinus jeffreyi*, taxonomy.

MATERIAL AND METHODS

Only one collection of *Tricholoma albidulum* has been studied; however, the combination of macroscopic and, above all, the typical microscopic features seem delimitative to describe this taxon as a new species.

The microscopic study has been made using a Nikon Labophot microscope equipped with an automatic photographic system. All the samples were studied in NH_4OH 10 % and Melzer's reagent. The holotype is kept at the Herbarium of the University of Alcalá (AH).

Tricholoma albidulum Ayala, G. Moreno & Esteve-Raventós *sp. nov.* (Figs. 1-2).

Latin diagnosis: *Pileus* 2.5-5 cm *diam., convexus vel plano-convexus. Pileipellis albida vel nivea, velutina, non hygrophana. Margo decurvatus vel planus. Lamellis uncinatis vel adnatis, albidis vel tenuiter cremeis. Stipes* 4-6 x 1-1.5 cm, *cylindricus, tereti, ad basim claviformibus, concoloris, fistulosus, pruinosus versus apicem. Caro albida, odore indistincto. Sapore vix notatus. Pileipellis hyphis cylindri. Caro albida, odore indistincto. Sapore vix notatus. Pileipellis hyphis cylindricis, hyalinis, ramificatis,* 4-6.5 µm *diam., efformatibus; hyphis terminalis capitatis vel subcapitatis. Basidiis* 34-38 x 9-11 µm, *tetrasporis, claviformibus. Sporis* 7-7.5 x 5-6.5 µm, *globosis vel late ellipsoideis, hyalinis, inamyloideis, indextrinoideis. Cystidiis hymeniales fibulisque non observatus.*

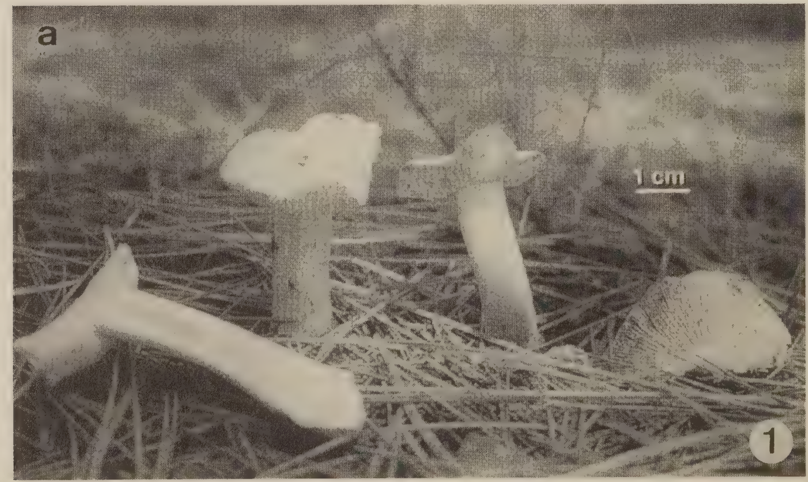

Fig.1.- ***Tricholoma albidulum*** **AH 18145 (*Holotypus*).** a. Fruitbodies.

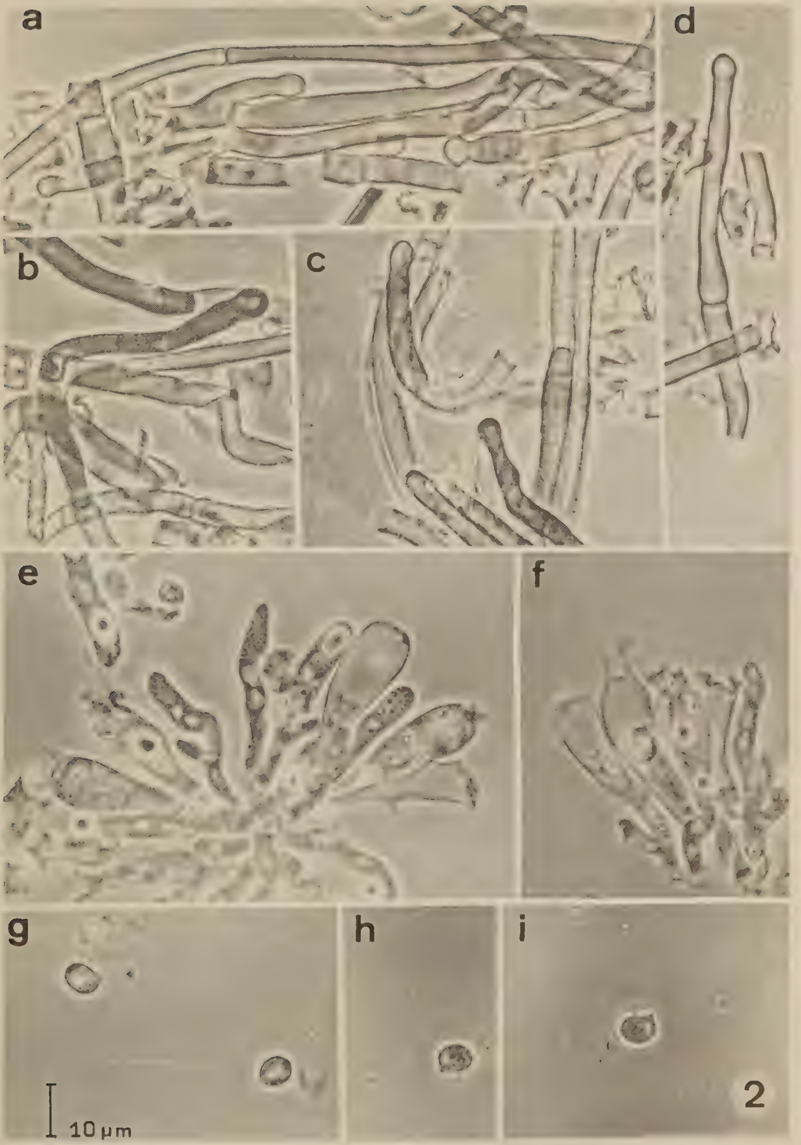
a
d
b
c
e
f
g
h
i
10 µm
2

Fig.2.- ***Tricholoma albidulum*** **AH 18145 (*Holotypus*).** a-d: terminal cells of the pileipellis; e-f: basidia and basidioles; g-i: spores.

Material studied: MEXICO: Baja California, Sierra Juárez, Laguna Hanson, in conifer forest with predominance of *Pinus jeffreyi* Grev. & Balf., 8-IX-1994, *leg.* H. López & N. Ayala, ***Holotypus*** AH 18145, *Isotypus* BCMEX 2673.

Pileus 2,5-5 cm diam., convex to plano-convex, white to cream, especially at the disk, velutinous, non hygrophanous, margin decurved to flat. Lamellae fairly crowded, adnate to emarginate, whitish to cream with age. Stipe 4-6 x 1-1,5 cm, cylindrical to clavate, concolorous, sometimes ochraceous at the base, hollow, distinctly pruinose at the apex. Flesh white, browning on handling; odor and taste fungoid.

Pileipellis a cutis consisting of cylindrical branched hyphae, 4-6,5 µm in diam., with distinctly capitate terminal cells. Basidia 34-38 x 9-11 µm, 4-spored, clavate. Spores 7-7,5 x 5-6,5 µm, globose to broadly ellipsoid, hyaline, non amyloid, non dextrinoid. Cystidia not observed. Stipitipellis similar to pileipellis, with the same capitate terminal cells. Clamp-connections absent.

Observations: *Tricholoma albidulum* is characterized by the completely white fruitbodies, cylindrical to clavate stipe with pruinose apex, globose to broadly ellipsoid spores and its typical pileipellis which is a cutis with capitate terminal cells.

This new species should probably be included in section *Polyphyllina* (SINGER, 1986), which members are characterized by the absence of clamps, odorless flesh, subclose to crowded lamellae, and fruitbodies almostl entirely devoided of pigment, which are not viscid.

Tricholoma columbetta (Fr.) P. Kumm. and *T. virgineum* (Murrill) Murrill share the whitish colors of the fruitbodies but both show different microscopic characters. *T. columbetta*, a well known European species, has smaller spores [(5-)6-7 x 4-5 µm according to BON (1984); 5-5,5(-6,5) x 4,2-5,5 µm according to

RIVA (1988)], and the pileipellis is different. According to HESLER's (1958) study of the type of *T. virgineum*, the latter taxon differs from *T. albidulum* in having a pileipellis formed by broader hyphae (2-3 µm diam.) and longer ellipsoid spores (8-12 x 4,5-6 µm).

Shanks (pers.comm.) admits not to have come across this taxon before, not even in her revision of the genus *Tricholoma* in California (SHANKS, 1994; 1996).

ACKNOWLEDGMENTS

This work has been possible through a research project included in the "Programa de Cooperación con Iberoamérica, Ministerio de Educación y Ciencia, Subdirección General de Cooperación Internacional", Spain, and through research project DGICYT PB 91-0165. Dr. N. Ayala wishes to express her gratitude to the "Consejo Nacional de Ciencia y Tecnología (CONACYT)" of México for granting a fellowship to undertake a Ph. D. thesis on the Agaricales of Baja California. We wish to express our gratitude to K. Shanks, for her valuable comments and for the bibliographic information.

BIBLIOGRAPHY

BON, M. (1984). *Les tricholomes de France et d'Europe occidentale*. Éditions Lechevalier. Paris.

HESLER, L. R.(1958). Southeastern Agaricales, II. *J. Tenn. Acad. Sci*. 33 (3): 186-191.

RIVA, A. (1988). *Tricholoma (Fr.) Staude. Fungi Europaei 3.* Libreria editrici Giovanna Biella. Saronno.

SHANKS, K. (1994). *A systematic study of Tricholoma in California. Thesis of Master of Arts in Biology, Ecology and Systematic Biology*. University San Francisco State.

SHANKS, K. (1996). New species of *Tricholoma* from California and Oregon. *Mycologia* 88 (3):497-508.

SINGER, R. (1986). *The Agaricales in modern taxonomy*. 4 ed. Koeltz Scientific Books, Koenigstein.

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ADDITIONS TO THE CHEMISTRY, ECOLOGY AND DISTRIBUTION OF PELTIGERA MELANORRHIZA AND P. NEOPOLYDACTYLA

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Abstract: New data about the chemistry, ecology and distribution of two species belonging to the *Peltigera hymenina* group (*Peltigera melanorrhiza* and *P. neopolydactyla)* are given for Europe. A new chemotype within *P. melanorrhiza* is described and this taxon is recorded as new for continental Europe. A discussion about the *P. neopolydactyla* morphotypes and chemotypes is given, its distribution area is shown to extend towards temperate and oceanic areas in south-western Europe.

Introduction

The lichen genus *Peltigera* has recently been studied in the Iberian Peninsula (Martínez & Burgaz 1993, Martínez et al. 1996), who enumerate 22 species in this area. Nevertheless, two species of the *P. hymenina* group are here recorded as new to the Iberian *Peltigera* flora, which also represent a great extension in their European distribution area. The study of secondary lichen products was performed from acetone extracts by thin layer chromatography (TLC) according to standardized procedures (White & James 1985). The material studied is deposited in the private collection of Isabel Martínez (HIMM).

Results

Peltigera melanorrhiza Purvis, P. James & Vitik.

P. melanorrhiza is characterized by ± overlapping apices and indented margins. Lower surface has blackish brown radiating veins, and fasciculate and tufted rhizines are also blackish brown. The red-brown saddle-shaped apothecia, are located on short lobe extensions.

One sample was collected from Spain (north-west of Cáceres Province, Fig. 1), very near to the Portuguese border, is morphologically very similar to *P. melanorrhiza,* a species recently described by Purvis & James (1993) and only recorded from the Azores (Portugal). Comparison of the Spanish sample with the type material deposited in BM herbarium and checking the chemistry by TLC revealed some chemical differences,

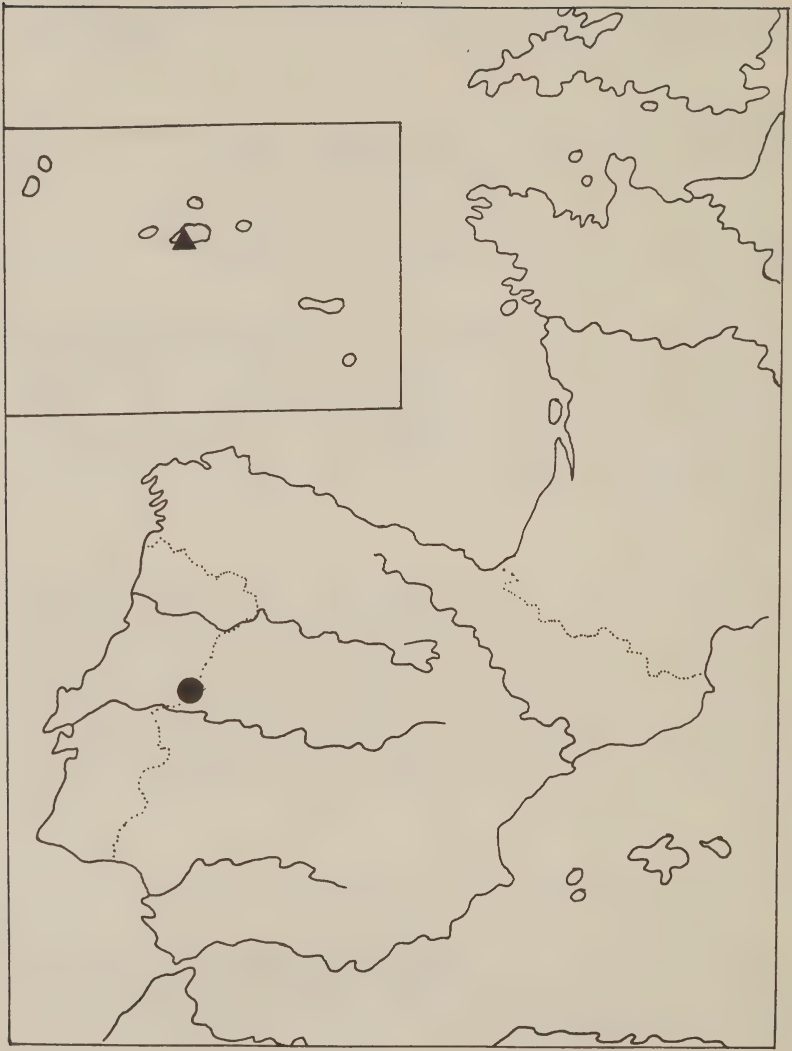

Fig. 1. Distribution of *Peltigera melanorrhiza* in Europe. ▲ previous records, ● new record.

although its morphology is very similar to the type of *P. melanorrhiza*.

According to Purvis & James (1993), *P. melanorrhiza* contains tenuiorin, methyl gyrophorate, gyrophoric acid, an unidentified terpenoid with a rf value similar to methyl gyrophorate in solvent G, dolichorrizin and zeorin. The Spanish specimen presents tenuiorin, methyl gyrophorate, gyrophoric acid (trace), peltidactylin, dolichorrizin and zeorin (trace). We consider that the Spanish sample represents a new chemotype within *P. melanorrhiza,* having peltidactylin instead of the unidentified terpenoid. Then, *P. melanorrhiza* would have two different chemotypes: chemotype I in the Azorean material and the chemotype II in the Spanish material.

Our material was collected on slopes with *Erica australis* shrubs in areas with a special climate, very humid (Pm = 1365 mm) and thermic (Tm = 15.5ºC), in altitudes around 1300 m. These conditions would favour the establishment of this species because the climatic conditions are similar to that described in the Azores. Probably this taxon may have a wider distribution in localities with similar climate in southern Europe.

Material studied: **Portugal**: Azores: Cerrado de Sonicas, c. 200 m along track leading off road EN 3 to aerial, alt. 900 m, 11-IV-1992, O. W. Purvis & P. W. James, BM. **Spain**: Cáceres: Acebo, sierra de Gata, Jálama mountain, 29TPE9156, 1200 m, granitic slopes in *Erica australis* shrubs, 3-IV-1996, G. Aragón, A. Herrero & I. Martínez, HIMM1175.

P. neopolydactyla (Gyeln.) Gyeln.

P. neopolydactyla was described by Gyelnik (1932) from Sweden. Recently, Vitikainen (1994) mapped this taxon, and its distribution proved wider, resulting a circumboreal, boreal to artic species, its western known limit in Europe being in the French Alps. With new records reported here its distribution is enlarged southwards to the Iberian Peninsula. (Fig. 2).

P. neopolydactyla is morphologically and chemically very variable, and Holtan-Hartwig (1993) described three morphotypes and four chemotypes in this species. Also, Vitikainen (1994) pointed out this variability. Our new material presents additional differences in morphology and chemistry, too. Three samples look like the morphotype B of Holtan-Hartwing (1993), with very big and thin thallus, greyish blue upper side and pale brown and less distinct veins on the under side. In this morphotype we found out the chemotypes II (tenuiorin, methyl gyrophorate, gyrophoric acid, peltidactylin, dolichorrhizin and zeorin) and III (tenuiorin, methyl gyrophorate, gyrophoric acid, peltidactylin and zeorin).

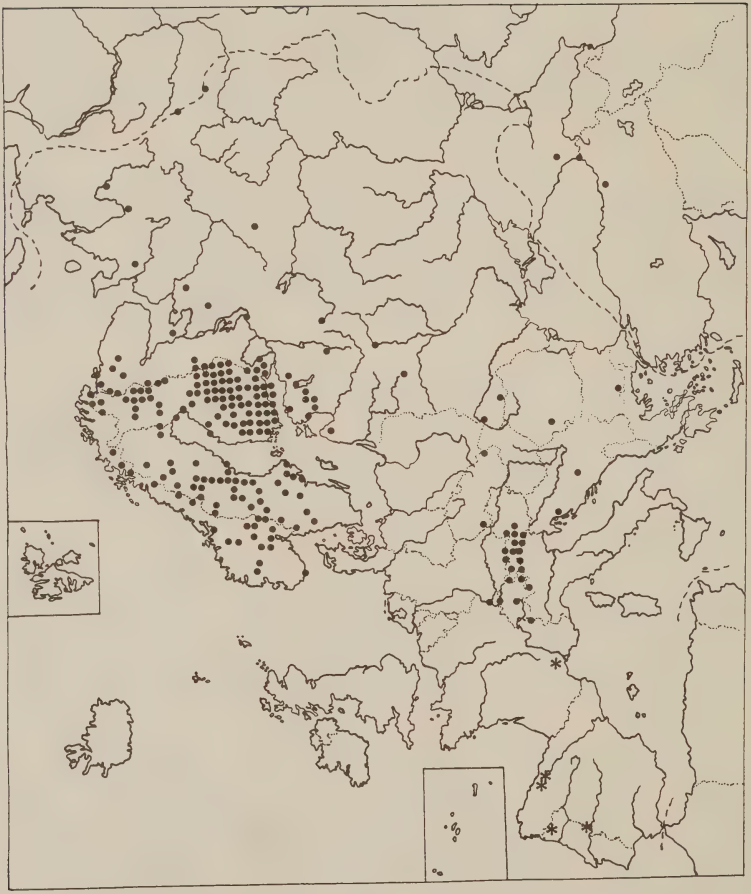

Fig. 2. Distribution of Peltigera neopolydactyla in Europe and adjacent areas. ● previous records, * new records.

Two samples are similar to the morphotype C, having a thick thallus, brown upper side, very black network of veins with few interstices disappearing towards the centre, and black and bush-shaped rhizines. Following Holtan-Hartwig (1993) this morphotype C should only represent the chemotype IV (tenuiorin, methyl gyrophorate, gyrophoric acid, zeorin and Pnp-1), but the chemistry of our material is like the chemotype II.

Finally, a new morphotype 'D' may be recognized in three of our samples. It is characterized by narrow lobes with ascending margins, brown upper side, dark brown network of veins with numerous oblong interstices, and slightly branched and long rhizines. In this morphotype the chemotypes II and III are presented.

P. neopolydactyla is predominantly saxicolous, or grows on bases of deciduous trees or terricolous, generally among or over mosses. Vitikainen (1994) underlined that this taxon is rarer in oceanic areas than in more continental ones. Nevertheless, our material was growing on slopes with few mosses but in more or less oceanic areas avoiding continental situations, and always in forested sites with acid substrate.

The morphological and chemical variability of this species is still very great, so future studies are necessary to elucidate its taxonomical limits.

Material studied: **Morphotype B**. **France**: Gard: Chamborigaud, 350 m, on slate slopes, 31-VIII-1993, A. Herrero, HIMM899. **Spain**: Asturias: Ponga, between Villarcazo and Cazo, 30TUN19, 650 m, very wet slopes, *Fagus sylvatica* with *Betula pendula* forest, 3-VII-1995, A.R. Burgaz & I. Martínez, HIMM744; Ponga, Beleño, los Bedules, 30TUN2585, 975 m, acid slopes, *Corylus avellana* formations, 3-VII-1995, A.R. Burgaz & I. Martínez, HIMM748. **Morphotype C**. **Spain**: Cantabria: Vega de Liébana, Tudes, 30TUN6876, 680 m, on soil in *Quercus ilex* ssp. *ballota* forest, 6-VI-1994, A.R. Burgaz, HIMM895; Saja, valley Saja river, 30TUN97, 650 m, on acid soil in *Fagus sylvatica* forest, 15-VIII-1991, G. Aragón & I. Martínez, MACB 44618. **Morphotype D**. **Portugal**: Minho: Serra Amarela, Lourido, 29TNG63, 200 m, on acid slopes, *Alnus glutinosa* formations, 16-VI-1995, A.R. Burgaz & I. Martínez, HIMM685; Serra do Soajo, Adrão-Gavieira, 29TNG64, 750 m, on granitic rocks, 17-VI-1995, A.R. Burgaz & I. Martínez, HIMM689, HIMM691. **Spain**: Cáceres: San Martín de Trevejo, sierra de Gata, Vega river, 29TPE8856, 800 m, granitic slopes, *Castanea sativa* formations, 4-IV-1996, G. Aragón, A. Herrero & I. Martínez, HIMM1209.

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Bibliography

Gyelnik, V. (1932). Lichenes suecici novi. Magyar Bot. Lapok 31: 46-47.
Holtan-Hartwing, J. (1993). The lichen genus *Peltigera*, exclusive of the *P. canina* group, in Norway. - *Sommerfeltia* 15: 1-77.
Martínez, I. & Burgaz, A. R. (1993). Estudio del género Peltigera en España peninsular. - *Cryptogamie, Bryol. Lichénol.* 14: 341-352.
Martínez, I., Burgaz, A. R. & Vitikainen, O. (1996). Studies on Peltigera genus in the Iberian Peninsula. II. - *Nova Hedwigia* (in press).
Purvis, O. W. & James, P. W. (1993). Studies on the lichens of the Azores. Part 1 - Caldeira do Faial. - *Arquipélago, Cienc. Biol. Marin.* 11A: 1-15.
Vitikainen, O. (1994). Taxonomic revision of *Peltigera* (lichenized *Ascomycotina*) in Europe. - *Acta Bot. Fennica* 152: 1-96.

MYCOTAXON

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MACROMYCETES OF BAJA CALIFORNIA SUR, MEXICO

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ABSTRACT

Baja California Sur is an arid state in northwest Mexico. Suitable habitats for macrofungi are restricted to an isolated mountainous region in the extreme south where these kinds of organisms seem to be as diverse as those in similar communities in the woodlands of mainland Mexico. Only a few taxa could be found in the widespread desert environment of the lowlands. This study adds 63 taxa to the previous macromycete listings of Baja California Sur.

INTRODUCTION

Baja California Sur (23°N to 28°N, and 109°30'N to 115°W) is one of the most arid states of Mexico. It lies in the southern half of the Baja California peninsula. It is characterized by the presence of xeric plant communities belonging to the Sonoran Desert floristic province, which covers the extensive lowlands.

In the southern tip of this state, the geography is dominated by the Sierra de La Laguna range (2200 m high), a narrow mountain country where foothills harbor a dry tropical forest community and the mountain tops an oak-pine woodland.

The knowledge of vascular plants for this state is extensive (Shreve and Wiggins 1964, Wiggins 1980). Complementary intensive floristic studies on the vascular flora have been done in several areas (León de la Luz and Domínguez 1989, León de la Luz *et al.* 1995), but studies of other groups of plants are scarce and partial; *i. e*. Bowers *et al.* (1976) studied mosses and Patrón *et al.* (1985) compiled data on some lichens.

Fungi seem to be the least known group of organisms in the state. Although the study of Ayala and Guzmán (1984) summarized the existence of 118 species (5 Ascomycetes and 113 Basidiomycetes) in the peninsula, the bulk of these came from the northern state where the massive San Pedro Mártir range (3000 m) covers a large region of the country. This range is separated from the Sierra de La Laguna by 8° in latitude. Its summit also harbors woodland communities dominated by coniferous trees. Guzmán (1963), Guzmán & Herrera (1969), and Moreno *et al*. (1995) compiled a list of arid zone macrofungi in Mexico. A small portion of those are related to Baja California Sur.

This work contributes to the knowledge of the mycobiota of Baja California Sur, where explorations over several years, mainly in the mountainous region, have yielded an important volume of collections. The attached checklist is composed for 65 entries, of which 63 are new for the state. Collections from the xeric lowlands, although sparse in number, yield knowledge of the distribution of the macrofungi of the Mexican arid zones.

MATERIALS AND METHODS

Collection sites:

Table 1 shows the collecting areas. The numbers (1 to 4) are used to locate the collection site of each entry on the annotated checklist.

Location 1 is an isolated oak-pine woodland (around 150 km²) related floristically to those of the Sierra Madre Occidental in mainland Mexico. The dominant plant species are *Quercus tuberculata*, *Quercus devia*, and *Arbutus peninsularis*. In this community, fungi have an important role as mycorrhizae with higher plants, in the decomposition of dead plants, and in parasitizing plants, controlling the populations. Although this area seems to have two rainy seasons (summer and winter), only in the first do fruiting bodies develop.

Location 2 is a transitional community between the Sonoran Desert and the Cape Region of Baja California, with both arid and tropical features. The dominant species in this community are cacti such as *Pachycereus pringlei*, *Lophocereus schotii*, *Machaerocereus gummosus*, and *Lemairocereus thurberii*.

Location 3 is a hyperarid site in the middle of the Baja California peninsula. Finally, location 4 is in the tropical deciduous forest in the southern part of the state, with both tropical and xerophitic characteristics.

Methodology.

Most of the specimens were photographed at the time of collection to take in account features like shape and natural colors, which are useful for identification. The samples were dried by conventional methods.

All specimens were collected by J. L. León de la Luz and delivered to E. Pérez Silva for identification and are part of the national mycological collection housed at the MEXU Herbarium (Instituto de Biología, Universidad Nacional Autónoma de México, UNAM).

In the laboratory, dry specimens were rehydrated briefly in 5% aqueous KOH. The mounts were then flooded with water. Photographs of basidia and spores were taken from sections prepared in lactophenol cotton blue and Melzer's reagent. Electromicrophotographs were made using a Jeol JSM 5200 SEM. Samples were treated in a Polaron E 2000 sputter coater for 60 s at 1.2 Kv and 20 μA in an atmosphere of argon to obtain a golden coat of 500 Å.

RESULTS AND DISCUSSION.

A total of 65 species of macromycetes were identified, 6 from the lowlands and 59 from the woodland. All of them, except *Laccaria laccata* and *Gyrophragmium dunalii*, represent the first record for the state. Entries on the attached list consist of the up-to-date nomenclature for each taxon, some morphological remarks, collecting date and location (referred as 1, 2, 3 and 4, see table 1), and finally collector and curatorial data.

Most of the species diversity are concentrated in the genera *Amanita* (9), *Inocybe* (5), *Helvella* (3), *Russula* (3) and *Phellinus* (3), all of these from the oak-pine woodland.

The Sierra de La Laguna woodland represents a disjointed plant community with similar ones located hundreds of kilometers away. This study represents a relevant contribution for the knowledge of the macromycete distribution existing in these communities. It is also the first comprehensive treatment for this isolated area of Mexico for this group of organisms. Biogeographically, the woodland mycobiota are composed of fungi from both tropical and temperate areas.

Thirteen of the woodland fungi are reported elsewhere as edible, but in the native culture of Baja California Sur, they are unknown. The description and study of edible macromycetes must be a priority task because they represent a natural resource to be explored for the future. Subsequent ecological studies must consider the interactions between fungi and higher plants.

These kind of organisms are poorly represented in xeric areas. Our samples are components of the basic mycobiota for this kind of communities in mainland Mexico. Additional species previously reported for this environment are: *Mycenastrum corium* (Guer.) Desv. and *Battarrea stevenii* (Libb.) Fr. (Ayala *et al.* 1984 and Ochoa *et al*. 1990). Harkness (in Brandegee 1889) cites *Podaxon carcinomale* Desv., *Tulostoma obesum* Cke. & Ellis and *T. mammosum* Mich. for the pacific coast of the state.

We hope we have collected > 90% of the macromycetes native to this state. Forthcoming studies must be planned to collect more intensively in the mountainous area, during a hard rainy season, covering more terrain, mainly in ravines and shaded brooks.

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Table 1

1.- Sierra de La Laguna mountains, Municipio de La Paz near Valle de La Laguna, 1,800 m above sea level around 23°28'N and 109°57'W. Collection dates were 27/28 Sep. 1992 and 17 Sep. 1993.

2.- El Comitán, Municipio de La Paz, 24°08'N and 110°11'W, 10 to 20 m above sea level. Collection dates: 11 Nov 1991, 16 Feb 1992, 16 Mar 1992, 14 Apr. 1992.

3.- Punta Abreojos, Vizcaino Desert, Municipio de Mulege (27°50'N and 110°12'W). Collection date 28 May 1992. On the beach.

4. San Bartolo, Municipio de La Paz, 23°51' N 109°59'W, 180 m altitude. Collection date 25 Jul. 1994.

LITERATURE CITED

Ayala, N. & G. Guzmán. 1984. Los hongos de la Península de Baja California I. Las especies conocidas. Bol. Soc. Mex. Mic. 19: 73-91.

Ayala, N., C. Ochoa & G. Guzmán. 1985. Los hongos de la península de Baja California II. Las especies conocidas de *Tulostoma*. Rev. Mex. Mic. 1: 462-469.

Bowers, F. D., C. Delgadillo & A. J. Sharp. 1976. The mosses of Baja California. Journ. Hattori Bot. Lab. No. 40:397-410.

Brandegee, T. S. 1889. Plants from Baja California. Proc. Cal. Acad. Sci. Ser. 2 Vol II. 232 p.

Guzmán, G. 1963. Macromicetos de las zonas áridas de México I. Análisis taxonómico, ecológico y fitogeográfico de la investigación bibliográfica. An. Esc. Nal. Cienc. Biols. Mex. 12: 43-60.

Guzmán, G. y T. Herrera. 1969. Macromicetos de las zonas áridas de México II. Gasteromicetos. An. Ins. Biol. Univ. Nal. Aut. Mex., Ser. Bot. 440:1-92

León de la Luz, J. L. & R. Domínguez. 1989. "Flora of the Sierra de La Laguna, Baja California Sur, Mexico". Madroño 36:2:61-83.

León de la Luz, J. L., R. Coria B. & J. Cansino. 1995. Reserva de la Biósfera El Vizcaíno, Baja california Sur. *in*: Listados Florísticos de México. Instituto de Biología, UNAM. 29 p.

Moreno, G., A. Altés, C. Ochoa & J. E. Wright. 1995. Contribution to the study of Tulostomataceae in Baja California, Mexico. Mycologia 87: 96-120.

Ochoa, C., N. Ayala, G. Guzmán & L. Montoya-Bello. 1990. Contribución al conocimiento de los Gasteromicetes de la península de Baja California, México. Brenesia 33: 51-60.

Patrón, E., N. Ayala & G. Guzmán. 1985. Los líquenes de la Península de Baja California. I. Las Especies Conocidas. Rev. Mex. Mic. l: 451-463

Pérez-Silva, E. & T. Herrera. 1991. Iconografía de los macromicetos, I: *Amanita*. Publicaciones Especiales 6, UNAM.

Shreve, F. & I. L. Wiggins. 1964. Vegetation and Flora of the Sonoran Desert, 2 vols. Stanford University Press. Stanford, Cal. 1740 p.

Wiggins, I. L. 1980. Flora of Baja California. Stanford University Press, Cal. 1025 p.

Annotated Checklist

ASCOMYCETES

Hypomyces lactiflorum (Schw. Fr.) R. L. Tul.
Remarks: This species grows on basidiocarps of *Lactarius* or *Russula*. It is a widespread fungus characterized by the red color of the agaric. Found on humus in oak-pine woodlands. Edible, but not in this zone (fig. 6).
Material studied: JLLL 5093, (27-28/9/1992) 1; MEXU 23773. JLLL 6851 (17/9/1993); 1, MEXU 23958.

Helvella crispa Scop. : Fr.
Remarks: This species grows on soils of oak-pine woodlands.
Material studied: JLLL 5066 (27-28/9/1992); 1, MEXU 23754.

H. lacunosa Afs. : Fr.
Remarks: This species is solitary or gregarious, terricolous in oak-pine woodlands.
Material studied: JLLL 5043, 5097 (27-28/9/1992); 1, MEXU 23736, 23777. JLLL 6869 (17/9/1993); 1, MEXU 23955.

H. macropus (Pers. : Fr.) Karst.
Remarks: On soil in oak-pine woodlands. Not edible.
Material studied: JLLL 6856, 6884 (17/9/1993); 1, MEXU 23949, 23960.

Peziza vesiculosa Bull. : St./Amans.
Remarks: On humus in oak-pine woodlands, gregarious.
Material studied: JLLL 6007, 6884 (27-28/9/1992); 1, MEXU 24005.

APHYLLOPHORALES

Clavulina cristata (Fr.) Schwein.
Remarks: This species grows on humus, solitary or gregarious in oak-pine woodlands.
Material studied: JLLL 5043 (27-28/9/1992); 1, MEXU 23736.

HYMENOCHAETACEAE
Coltricia hamata (Room.) Ryv.
Remarks: This species grows on soil and wood, solitary.
Material studied: JLLL 5073 (27-28/9/1992); 1, MEXU 23760. JLLL 6852 (17/9/1993); 1, MEXU 23940.

C. perennis (L. : Fr.) Murril.
Remarks: Basidiocarps annual, stipitate, pileus circular, zoned, ochraceous, hard when dry, upper surface velvety tomentose. On the ground in coniferous forest, widely distributed.
Material studied: JLLL 6011 (27/9/1992); 1. MEXU 23787.

Phaeolus schweinitzii (Fr.) Pat.
Remarks: This taxon has been placed in the Hymenochaetaceae because the surface of basidiocarps and the hymenium turn dark in KOH. The spores are ovoid, hyaline, smooth with setae absent. Commonly occurs on *Pachycereus pecten-aboriginum* in this area.
Material studied: JLLL 7163 (25/07/1994); 4, MEXU 24377

Phellinus igniarius (Fr.) Quél.
Remarks: This taxon is easily recognized by its bracketlike perennial basidiocarps, brown-blackish, flesh hard, woody, solitary on living hard wood.
Material studied: JLLL s/n (27-28/9/1992); 1, MEXU 23573

P. ferrugineovelutinus (Henn.) Ryv.
Remarks: On wood of *Lysiloma divaricata*.
Material studied: JLLL 6021 (27/9/1992), 1. MEXU 23938. JLLL 6902 (17/9/1993); 1, MEXU 24003.

P. rimosus (Berk.) Pilát
Remarks: On wood of *Lysiloma divaricata*.
Material studied: JLLL 5039 (14/4/1992); 2, MEXU

GANODERMATACEAE

Ganoderma lobatum (Schwein.) Atk.

Remarks: On *Cercidium floridum* wood, associated with roots of living and dead shrubs and trees.

Material studied: JLLL 5041 (16/3/1992); 2. MEXU 23576.

Humphreya coffeatum (Berk.) Stey.

Remarks: On *Bursera microphylla.* Apparently it has an ample distribution in Mexico. The basidiospores bitunicate, are very characteristics in SEM, the exosporium at first is wrinkled, later in the maturite, showed a clear reticulation (Figs. 1, 2)

Material studied: JLLL 6022 (27-28/9/1992); 1. MEXU 23792.

POLYPORACEAE

Cerrena unicolor (Bull. : Fr.) Murr.

Remarks: Common on dead wood.

Material studied: JLLL 5067 (27/9/1992); 1, MEXU 23755.

Fomes everhartii (Ell. & Gall.) Schrenk. & Paul

Remarks: A typical species common on dead and living wood in the coniferous forest .

Material studied: JLLL s/n (27-28/9/1992); 1, Det. G. Guzmán (XAL s/n)

Hexagona hirta (Fr.) Fr.

Remarks: Common on dead and living wood.

Material studied: JLLL 5096 bis (27-28/9/1992), 6895 (17/9/1993); 1, MEXU 23776, 23945.

SPARASSIDACEAE

Sparassis crispa Wulfen : Fr.

Remarks: On soil, probably associated with a white rot of dead coniferous wood.

Material studied: JLLL 5063 (27/9/1992); 1, MEXU 23752.

STEREACEAE

Stereum ostrea (Blum. & Nes. : Fr.) Fr.

Remarks: Associated with a white rot of dead conifer wood.

Material studied: JLLL 5084 (28/9/1992); 1, MEXU 23767.

AGARICALES

HYGROPHORACEAE

Hygrophorus chrysodon (Fr.) Fr.

Remarks: On soil, scattered in mixed woodlands.

Material studied: JLLL 5061, (27-28/9/1992); 1, MEXU 23751. JLLL 6853, (17/9/1993); 1, MEXU 24008.

TRICHOLOMATACEAE

Armillaria mellea (Fr.) Quél.

Remarks: This species is frequently associated with white rot and butt rot of conifers.

Material studied: JLLL 6893 (17/10/1993); 1, MEXU 23942.

Laccaria amethystina Cooke

Remarks: On soil, solitary to scattered, associated with deciduous and coniferous forest. Cited as ectomycorrhizal.

Material studied: JLLL 5044, 5045 (27-28/9/1992); 1, MEXU 23737, 23738.

L. laccata (Scopoli Fr.) Cooke

Remarks: On soil among pine needles. Also cited frequently as a mycorrhizal species.

Material studied: JLLL 6859 (17/9/1992); 1, MEXU 23951.

Marasmius ferrugineus (Berk.) Berk. & Curt.

Remarks: on leaves of *Quercus devia*.

Material studied: JLLL s/n (27-28/9/1992); 1, MEXU 24021

Omphalotus olearius (DC) Fr. Sing.
Remarks: On soil, on butt and root rot. Taxon reported as toxic. The bright orange color is very characteristic of this species.
Material studied: JLLL 6897, 6898 (17/9/1993); 1, MEXU 23944, 23956.

AMANITACEAE
Amanita bisporigera Atk.
Remarks: On soil, solitary.
Material studied: JLLL 5089 (27-29/9/1992); 1, MEXU 23749.

A. ceciliae (Berk. & Br.) Bas
Remarks: On soil, close to *Quercus devia*, probably mycorrhizal.
Material studied: JLLL 5076 (27/8/1992); 1, MEXU 23952. JLLL 6878 (17/9/1993); 1, MEXU 23761

A. crocea (Quél.) Singer.
Remarks: On soil, around *Quercus devia*. This species is recognized by the yellow color of the carpophore, annulus absent and volva saccate, free, edible.
Material studied: JLLL 5037, 5077 (27-28/9/1992); 1, MEXU 23762.

A. flavoconia Atk.
Remarks: On soil, close to Quercus sp. Size and shape of the carpophore put this exemplar in Section Validae. This taxa has been reported in Baja California State (Ayala *et al*. 1984).
Material studied: JLLL 6877 (17/1993); 1, MEXU 23582.

A. gemmata (Fr.) Gillet
Remarks: On soil, solitary. This species is known in the oak-pine woodlands of Baja California state (Ayala *et al*. 1984).
Material studied: JLLL 6850, 6885 (17/1993); 1. MEXU 24007, 24375.

A. muscaria var. *formosa* (Pers. : Fr.) Bertillon
Remarks: On soil, around Pinus cembroides, probably mycorrhizal.
Material studied: JLLL 6876 (17/1993); 1, MEXU 24011 (Fig. 10).

A. fallax Tulloss & G. Wrigth
Remarks: On soil, close to *Quercus*. Solitary. This taxon has been reported as *A. valens* (Pérez-Silva & Herrera, 1991).
Material studied: JLLL 6010 (27-28/9/1992); 1, MEXU 23786, 23794 (Fig. 8)

A. strobiliformis (Paul. : Vitt.) Bertillon
Remarks: On soil, around *Quercus* trees. This species could have variable forms, but is easily recognized by the color, white to pale grey. The form of the stipe always napiform and the volva remains subfloccose-felted, forming one or more ridges.
Material studied: JLLL 5062 (27-28/9/1992); 1, MEXU 23795. (Fig. 7).

A. vaginata (Bull. : Fr.) Vitt.
Remarks: On soil, close to *Quercus* trees, solitary. This species has a free saccate volva and annulus absent. It is an edible mushroom, but not well known in this region.
Material studied: JLLL 50044, 5055, 5079 (27-28/9/1992); 1, MEXU 23746, 23747, 24001.

PLUTEACEAE

Pluteus cervinus (Schaef. : Fr.) Kummer
Remarks: On rotting wood, solitary. An edible mushroom (Singer, 1984). This taxon has brown-greyish pileus and pink free lamellae.
Material studied: JLLL 5068, 5069 (27-28/9/1993); 1, MEXU 23756, 23758.

AGARICACEAE

Agaricus silvaticus Schaef. : Fr.
Remarks: On wood in oak-pine woodlands, rather than in open places, solitary. Surface of the pileus squamose. An edible mushroom, but not consumed in this area.
Material studied: JLLL 6004 (27-28/9/1992); 1, MEXU 23783.

COPRINACEAE

Panaeolus sphinctrinus (Fr.) Quél.
Remarks: On dung and soil. This species is recognized by a campanulate pileus, usually pigmented, appendiculate with a whitish veil. A poisonous species.
Material studied: JLLL 6000 (27-28/9/1992); 1, MEXU 23779.

Psathyrella candoleana (Fr.) Maire
Remarks: On soil, also on dung, solitary or in groups; probably edible, but not reported for this area.
Material studied: JLLL 6001, 6012 (27-28/9/1992); 1, MEXU 23780, 24673

STROPHARIACEAE

Psilocybe coprophila (Bull. : Fr.) Kummer
Remarks: Scattered to gregarious, on bovine dung, growing in cespitose groups, in open places, more common outside of temperate forest. Poisonous species of broad distribution.
Material studied: JLLL 5047 (27-28/9/1992); 1, MEXU 23779

Stropharia semiglobata (Batsh. : Fr.) Quél.
Remarks: On horse dung. This species grows in same habitat as the preceding one. The yellow color, slimy pileus with lilac-brown gills and a ring with a whitish stipe are some distinctive characteristics. Probably edible.
Material studied: JLLL 5080 (27-28/9/1992); 1, MEXU 23763

CORTINARIACEAE.

Inocybe calamistrata (Fr.) Gill.
Remarks: On Pinus cembroides wood, single to scattered. Pileus scaly dark-brown, stipe dark-brown, smoke greenish-blue below, spermatic odor, poisonous.
Material studied: JLLL 5085 (27-28/9/1992); 1, MEXU 23768 (Fig. 11).

I. cucullata Martin
Remarks: On soil in small groups. Small specimens with fibrillose pileus; stipe with white bulb below, spermatic odor, poisonous.
Material studied: JLLL 6014 (27-28/9/1992); 1, MEXU 23790

I. descissa (Fr.) Quél.
Remarks: On soil, solitary. Small specimens, pileus fibrous, brownish, stipe thin, whitish-yellow below, spermatic odor, poisonous.
Material studied: JLLL 5054 bis (27-28/9/1992); 1, MEXU 23745.

I. dulcamara (Alb. et Schw. Fr.) Kummer
Remarks: On soil, solitary or gregarious, pileus squamose, brownish, stipe with squamules near the upper side. Taste sweet to bitter, poisonous.
Material studied JLLL 5091 (27-29/9/1992); 1, MEXU 23771.
JLLL 6857 (17/9/1993); 1, MEXU 23788.

I. geophylla (Sow. : Fr.) Kummer
Remarks: On soil, solitary. Pileus whitish, fibrillose with a central knob, stipe concolorous, thick, dry, silky, pruinose at the tip. Odor spermatic. Widely distributed in Mexico. Poisonous.
Material studied: JLLL 5046 (28/9/1992); 1. MEXU 23739.

Phlegmacium calochrum (Pers. : Fr.) var. *coniferarum* Moser
Remarks: On soil, solitary. Exemplars of medium size, pileus ochraceus or olive shaded. Lamellae lilas to brownish with margined rounded bulb. Spores ornamented, amygdaliform.
Material studied: JLL 6015 (29/9/1992); 1. MEXU 24004.

P. multiformis (Fr.) var. *coniferarum* Moser
Remarks: On soil, solitary. Specimens of medium seize. Pileus brownish. Lamellae argillaceus. Spores amygdaliform in SEM, ornamented, with hilar appendages . Stipe white to brownish with a rusty mass spore, with margined bulb.
Material studied: JLLL 5053 (28/9/1992); 1, MEXU 24006 (Fig. 4)

Dermocybe cinnabarinus (Fr.) Wunsche
Remarks: On soil. Specimens of medium size, with the pileus glabrous, smooth, when young convex-umbonate. Lamellae concolorous and stipe.
Material studied: JLLL 5068 (28/9/1992); 1, MEXU 53757.

D. phoeniceus (Bull. Maire)
Remarks: On soil, solitary. Pileus brownish, finely fibrillose, lamellae narrow to broad with red pigments. Spores ornamented, worty-rough under SEM, without a germ pore and plage.
Material studied: JLLL 5060 (28/9/1992); 1 MEXU 23750 (Fig. 3).

RHODOPHYLLACEAE
Entoloma lividum (Bull. : Fr.) Quél.
Remarks: On humus, solitary. Pileus dark brown, lamellae adnate, pinkish, large. Stipe white. Spores nonamyloid, wall angular from all sides.
Material studied: JLLL 6089 (17/9/1993); 1, MEXU 23948.

PAXILLACEAE

Hygrophoropsis aurantiaca (Wolf. : Fr.) Maire
Remarks: On soil and wood. Species with red-yellowish pileus, stipe central or lateral, lamellae decurrent, context fleshy soft.
Material studied: JLLL 5050, 5051 (27-28/9/1992); 1, MEXU 23743, 23744.

BOLETACEAE

Boletus edulis Bull. : Fr.
Remarks: On soil, solitary. Easily recognized by its macroscopic characters on pileus and its reticulate stipe; context white without change in color. Reported as edible.
Material studied JLLL 6896 (17/9/1993); 1. MEXU 24562 (Fig. 14).

B. erythropus (Fr.) Pers.
Remarks: On soil, solitary. The stipe is solid, minutely pruinose, red to blue when injured. Probably edible.
Material studied: JLLL 6008 (27-28/9/1992); 1, MEXU 23785

Leccinum chromapes (Frost) Singer.
Remarks: On soil, solitary. The yellow color at the base of the stipe is a distintive characteristic. When injured, it is not darkened. Hymenophore whitish with free pores. Reported as edible.
Material Studied: JLLL 6874 (17/9/1993); 1, MEXU 24010.

L. nigrescens (Richon et Roze) Singer.
Remarks: On soil, solitary. Hymenophore yellow, with small pores. Probably edible and forming ectomycorrhizal.
Material studied: JLLL 5083 (27-28/9/1992); 1, MEXU 23766

STROBILOMYCETACEAE

Strobylomyces confusus Singer.

Remarks: Recognized by the black pileus and stipe, the first covered with erect warts mostly smaller, but sometimes cottony and not rigid. Flesh white, when bruised red. Spores with rough wall, which is the basic difference from *S. floccopus*, the nearest species. Solitary.

Material studied: JLLL 6003 (27-28/9/1992); 1 MEXU 21763. JLLL 6886 (17/9/1993); 1, MEXU 23941. (Fig. 13).

RUSSULACEAE

Russula emetica (Schaef. : Fr.) Gray

Remarks: A typical character is the red pileus and white lamellae and stipe. Flavor acrid. Solitary.

Material studied: JLLL 6013 (17/9/1992); 1, MEXU 23789. JLLL 5056 (27-28/9/1992); 1, MEXU 23748. JLLL 6861 (17/9/1993); 1, MEXU 23947.

R. ochroleuca (Pers.) Fr.

Remarks: Easily recognized in fresh conditions by the yellow pileus, lamallae and stipe white. Flavor acrid, solitary on the ground. Spores pale yellow.

Material studied: JLLL 5092 (27-28/9/1992); 1, MEXU 23772. JLLL 6017 (27-28/9/1992); 1, MEXU 23791.

R. cyanoxantha (Schaef. : Schw.) Fr.

Remarks: Recognized in field conditions by the violet to blue purple pileus, lamallae grayish and white stipe. Spores white. Solitary on ground. Reported as edible.

Material studied: JLLL 5049 (27-28/9/1992); 1, MEXU 23742

Lactarius indigo Schw. : Fr.
Remarks: Pileus and stipe fleshy, blue, lamallae decurrent, it drops a blue latex when injured. A typical ectomycorrhizal mushroom, edible. Widespread in the oak pine woodland.
Material studied: JLLL 5071 (27-28/9/1992); 1, MEXU 23759. (Fig 12).

GASTEROMYCETES
LYCOPERDALES
Lycoperdon candidum Pers.
Remarks: Solitary on the ground, probably edible when immature.
Material studied: JLLL 5094 (27-28/9/1992); 1, MEXU 23774.

L. perlatum Pers. var. *perlatum*
Remarks: The species is variable in shape and size; color from white to yellowish brown. Solitary to gregarious on the ground. Edible when inmature.
Material studied: JLLL 6863 (17/9/1993); 1, MEXU 23950.

PODAXALES
Gyrophragmium dunalii (Fr.) Zeller
Remarks: On *Lysiloma candida*
Material studied: JLLL 4957 (11/9/1991); 2. Det. G. Guzmán (XAL)

Montagnea arenaria (DC.) Zeller
Remarks: A gregarious species. Recognized by black basidiocarps and lamellae. Stipe with volva.
Material studied: JLLL 5037 (28/5/1992); 3, MEXU 23575.

Tulostoma volvulatum Borshov var. *volvulatum*
Remarks. Solitary individuals, growing on soils of arid zones.
Material studied: JLLL 5040 (16/II/92); 2, MEXU 23572.

Plate 1.

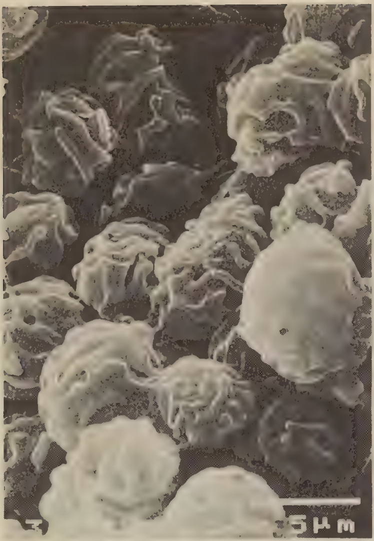
Fig. 1. *Humphreya coffeatum*, basidiospores surface.
Fig. 2. *H. coffeatum*, longitudinal section, scanning electron micrographs reveal that the endosporium form columns protected by the epispore.
Fig. 3. *Dermocyce phoeniceus*, perisporium layer in one young spore.
Fig. 4. *Phegmacium multiformis*, spore amygdaliform with a fine and discrete ornamentation.

Plate 2.

Fig. 5. Panoramic view of a Sierra de La Laguna habitat.
Fig. 6. *Hypomyces lactifluorum*, arrow shows sporulation.
Fig. 7. *Amanita strobiliformis*.
Fig. 8. *Amanita fallax*.
Fig. 9. *Amanita bisporigera*, detail of hymenium.

Plate 3.

Fig. 10. *Amanita muscaria* var. *formosa*.
Fig. 11. *Inocybe calamistrata*.
Fig. 12. *Lactarius indigo*.
Fig. 13. *Strobilomyces confusus*.
Fig. 14. *Boletus edulis*.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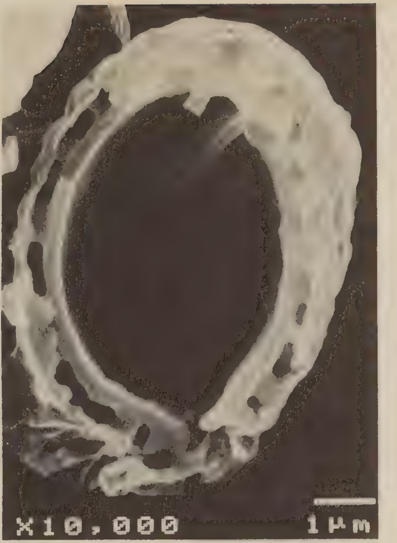
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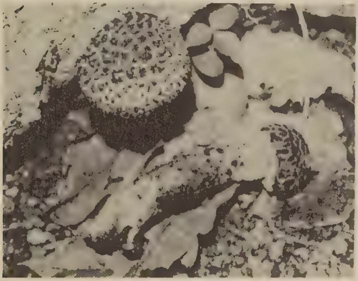

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FURTHER NEW SPECIES IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTINA) FROM AUSTRALASIA

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ABSTRACT : The following new lichen species are described; *Anzia entingiana* Elix, *Neofuscelia bulfiniana* Elix, *Neofuscelia depsidella* Elix and *Neofuscelia olivetorica* Elix from New Zealand; *Hypotrachyna toiana* Elix from Papua New Guinea and *Neofuscelia archeri* Elix, *Xanthoparmelia convolutella* Elix and *Xanthoparmelia orchardii* Elix from Australia.

Introduction

As a result of further study of the lichen family Parmeliaceae in Australasia (Elix 1994, 1995, 1996), I am describing 8 new species. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993; Elix et al. 1988), high performance liquid chromatography (Feige et al. 1993) and comparison with authentic samples.

Anzia entingiana Elix, sp. nov. Fig. 1

Species cum thallo ut in *Anzia jamesii* sed ab hac specie thallo parviore, lobis convexis, angustioribus et acido protocetrarico continente differt.

Type: New Zealand. North Island, Waitemata Co., Swanson, end of Tram Valley Road, 36°52'S, 174°34'E, *c.* 50 m, on kauri, *A. E. Wright 7528*, 22 March 1986; holo: AK.

Thallus corticolous, adnate to loosely adnate, orbicular to spreading, 2-5 cm wide. *Lobes* linear, separate or crowded, dichotomously to subdichotomously branched, 0.4-1.2 mm wide. *Upper surface* pale grey to pale grey-green, white at the margins, convex, smooth, distinctly maculate,

±transversely cracked, isidiate; isidia sparse to dense, cylindrical, simple becoming coralloid branched. Medulla white, with a chondroid axis of parallel, longitudinally arranged hyphae in middle of the lobes. *Lower surface* with continuous spogiostratum which often projects beyond the lobe margins, uniformly attached to lower medullary hyphae or chondroid strand, solid, dark brown to black; rhizines scattered, simple or tufted. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex yellow, medulla K-, C-, P+ orange-red; containing atranorin (minor), chloroatranorin (minor) protocetraric acid (major), virensic acid (trace).

Morphologically *A. entingiana* resembles *A. jamesii,* the other endemic species of *Anzia* from New Zealand. However, *A. jamesii* differs in having flattened, broader lobes (0.5-2.0 mm *cf.* 0.4-1.2 mm wide), thicker, shorter isidia, pruinose lobe tips and in containing anziaic acid (major) and 4-*O*-methylhypoprotocetraric acid (minor) in the medulla. In contrast, *A. entingiana* has narrower, convex lobes with thinner, taller isidia, epruinose lobes and contains protocetraric acid in the medulla. *A. entingiana* appears to be restricted to the north of the North Island of New Zealand, whereas *A. jamesii* is confined to the South Island. Previously, some sparsely isidiate specimens of *A. entingiana* were referred to as *A. madagascariensis* des Abb. (Galloway 1985), a species which does not occur in New Zealand. Although the small thalli with separate lobes of *A. madagascariensis* and *A. entingiana* are superficially similar, the former species lacks isidia and contains fumarprotocetraric acid rather than protocetraric acid. This new species is named in honour of our late colleague, photographer, lichen enthusiast and friend, Brian Enting (Galloway 1996a).

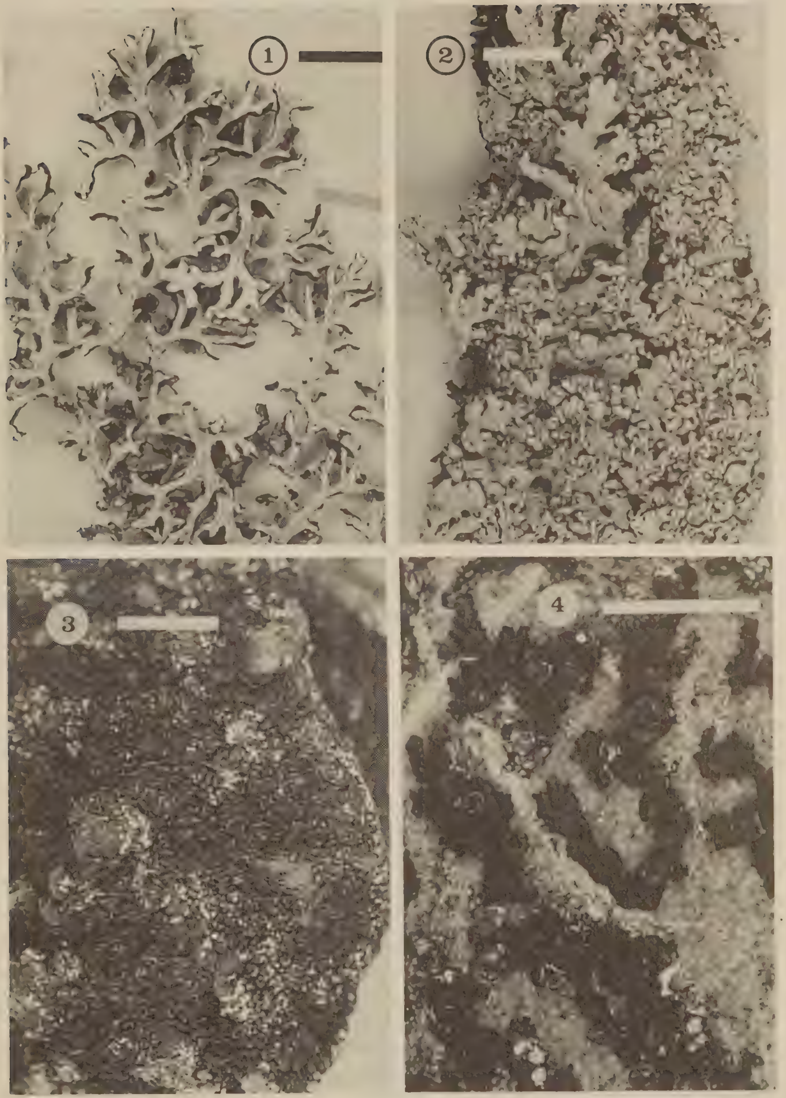
Specimens Examined

NEW ZEALAND. North Island, Mangonui Co., Church Road, Kaitaia, 35°11'S, 173°01'E, *J. K. Bartlett,* 3.x.1981 (AK); Radar Bush, 34°28'S, 172°46'E, *J. K. Bartlett* (AK 185287, AK 196770, WELT L2703); Whakatane Co., Whirinaki State Forest, 38°38'S, 176°58'E, *J. K. Bartlett,* 8.ix.1982 (AK); Te Paki Ecological Region and District, Radar Bush, 34°28'S, 172°46'E, *B. W. Hayward,* 14.v.1984 (AK).

Hypotrachyna toiana Elix, sp. nov. Fig. 2

Species cum thallo ut in *Hypotrachyna imbricatula* sed ab hac specie apicibus lobi lobulatis et revolutis, isidiis apicibus saepe erumpentibus et pigmento incognito continente differt.

Type: Papua New Guinea. Morobe Province. Aseki-Bulolo Road, 1.5 km NW of Aseki, 7°21'S, 146°11'E, 1580 m, on *Castanopsis* in regrowth forest, *J. A. Elix 12218 & M. Toia,* 17.ix.1994; holo: CANB.



Figures 1-4. New species of Parmeliaceae: 1, *Anzia entingiana* (holotype in AK); 2, *Hypotrachyna toiana* (holotype in CANB); 3, *Neofuscelia archeri* (holotype in CANB); 4, *Neofuscelia bulfiniana* (holotype in WELT). Scale bar = 5 mm.

Thallus foliose, adnate, corticolous, from 5-8 cm wide. *Lobes* often crowded, imbricate, sublinear, subdichotomously to irregularly branched, 1.5-3.5 mm wide; apices revolute, hooded. *Upper surface* pale yellowish grey, flat within to convex at apices, smooth and shiny at the tips, becoming white-maculate, isidiate and lobulate towards the centre, lacking soredia and pustules; isidia moderate to dense, cylindrical, simple or branched, apices epicorticate, ±inflated and erumpent; lobules revolute, 0.3-1.0 mm wide. Medulla white. *Lower surface* black, brown at the tips; rhizines dense, dichotomously branched. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow; medulla K-, C-, KC+ yellow-orange, P-; containing atranorin (major), chloroatranorin (trace), barbatic acid (major), obtusatic acid (trace), 4-*O*-demethylbarbatic acid (minor), norobtusatic acid (trace), unknown pigments (minor).

This species resembles *Hypotrachyna imbricatula* (Zahlbr.) Hale in having imbricate, sublinear lobes with cylindrical isidia and in containing the barbatic acid complex in the medulla. However, the apices of the lobes of *H. toiana* are revolute and hooded, while those of *H. imbricatula* are flat and truncate. Furthermore, the isidia of *H. toiana* are larger, epicorticate and ±bursting at the apices while those of *H. imbricatula* are shorter and finer with syncorticate apices which are intact, not inflated and ±darkened. Unlike *H. toiana, H. imbricatula* is elobulate. In addition to the barbatic acid complex, *H. toiana* contains several yellow pigments (the pigmentosa pigments) of unknown constitution which are absent in *H. imbricatula*. At present this species is only known from the type location and is named in honour of the Papua New Guinea forester and botanist, Martin Toia.

Neofuscelia archeri Elix, sp. nov. Fig. 3

Species cum thallo ut in *Neofuscelia subloxodella* sed ab hac specie subcrustoso, arcte adnato et lobis angustiore, ±areolato differt.

Type: Australia. Western Australia. Near Kalgoorlie, on laterite rocks, *M. F. Day 10859*, July 1982; holo: CANB.

Thallus small-foliose to subcrustose, tightly adnate, saxicolous, forming irregular rosettes to 2-5 cm wide. *Lobes* imbricate, irregular to sublinear, irregularly branched, 0.2-0.8 mm wide. *Upper surface* olive brown to dark brown or black brown, smooth and shiny at lobe apices, becoming dull, cracked and ±areolate in the thallus centre, isidiate; isidia sparse to dense, globose then short cylindrical, simple or very rarely branched; isidia apices epicorticate, inflated, ±erumpent. Medulla white. *Lower surface* pale brown to tan, darker at the apices; rhizines moderately dense, simple, concolorous. *Apothecia* and *pycnidia* not seen.

Chemistry. Cortex K-, HNO_3+ dark blue-green; medulla K-, C-, KC+ pink then orange, P-; containing glomelliferic acid (major), loxodellic acid (minor), perlatolic acid (minor), glomellic acid (minor), stenosporic acid (trace).

Like *Neofuscelia subloxodella* Elix & Kantvilas this new species is characterized by the pale lower surface, the presence of isidia and medullary glomelliferic, loxodellic and glomellic acids. However, these two species differ in their substrate preference, the size and adnation of the thalli, the nature of the minor medullary metabolites. Thus the thalli are saxicolous and tightly adnate in *N. archeri* but terricolous and moderately adnate to adnate in *N. subloxodella*. Furthermore, the lobes of *N. subloxodella* are broader (1-2 mm cf. 0.4-0.8 mm wide) than those of *N. archeri*. Further, *N. archeri* contains minor quantities of perlatolic acid, a substance which has not been observed in *N. subloxodella*. These two species are not sympatric, *N. archeri* occurring only in the goldfields area of Western Australia in contrast to *N. subloxodella* which occurs in South Australia and Tasmania. This new species is named in honour of the Australian lichenologist, Dr. Alan W. Archer.

Specimens Examined

WESTERN AUSTRALIA. Type locality, on laterite rocks, *M. F. Day 10469, 10858,* July 1982 (CANB).

Neofuscelia bulfiniana Elix, sp. nov. Fig. 4

Species cum thallo ut in *Neofuscelia martinii* sed ab hac specie acido barbatico et acido 4-*O*-demethylbarbatico continente differt.

Type: New Zealand. South Island, Canterbury, Tasman Glacier Valley road, Mount Cook National Park, 41°40'S, 170°10'E, on rock (moraine debris) in alpine herbfield, *J. Johnston 3555,* 10 Nov. 1989; holo: WELT.

Thallus small-foliose, adnate to tightly adnate, saxicolous, forming irregular rosettes, 2-3 cm wide. *Lobes* radiating, separate, elongate to linear-elongate, dichotomously branched, 1-2 mm wide. *Upper surface* dark brown to brown-black, the apices weakly to moderately convex, shiny, smooth or ±irregularly pitted, older lobes becoming strongly convex, dull, rugose, wrinkled-plicate and areolate; lacking soredia and isidia. Medulla white. *Lower surface* black, paler at tips, flat or rugulose; rhizines sparse, simple, thick, to 0.5 mm long, clustered, concolorous. *Apothecia* common, sessile, to 2 mm wide; disc shallowly concave to ±flat or subconvex, black-brown; thalline exciple smooth, margin thin, entire. Ascospores ellipsoidal, 8.5-10.5 x 5-6 μm. *Pycnidia* common, immersed. Conidia bifusiform, 4.5-6.5 x 1 μm.

Chemistry. Cortex K-, HNO_3+ dark blue-green; medulla K-, C-, KC+ yellow-orange, P-; containing barbatic acid (major), 4-*O*-demethylbarbatic acid (minor).

This species is characterized by the linear, convex lobes, the sparse, clustered rhizines and the presence of barbatic acid in the medulla. Three other endemic New Zealand species of *Neofuscelia* have similar morphology and are most reliably distinguished chemically - *N. martinii* (Essl.) Essl containing physodic acid, *N. peloloba* (Essl.) Essl containg alectoronic acid and *N. pictada* (Essl.) Essl. containing divaricatic acid. In addition, there are two further species which contain barbatic acid but which differ morphologically from *N. bulfiniana.* Thus *N. melanobarbatica* (Essl.) Essl. differs in having flat lobes with a pale tan to brown lower surface (lobes convex with a black lower in *N. bulfiniana*) while *N. atrobarbatica* (Elix) Essl. has flat, contiguous lobes with subfruticose laciniae (lobes convex, separate and elaciniate in *N. bulfiniana*). This new species appears to be confined to the mountains of the South Island of New Zealand and is named in honour of our late colleague, botanist and friend Margaret Bulfin (Galloway 1996b).

Specimen Examined

NEW ZEALAND. South Island, Mt. Cook, *W. H. Ewers 5221,* 10.xi.1989 (CANB).

Neofuscelia depsidella Elix, sp. nov. Fig. 5

Species cum thallo ut in *Neofuscelia pulla* sed ab hac specie acido decarboxystenosporonico, acido decarboxyanziaico et acido incognito continente differt.

Type: New Zealand. South Island, Otago, Lake Wanaka, 0.5 km west of Glendu Bluff, 300 m, on exposed rocks in pasture, *J. A. Elix 9842*, 4 Jan. 1982; holo: WELT.

Thallus foliose, saxicolous, loosely to moderately adnate, 3-6 cm wide. *Lobes* imbricate to loosely entangled, sublinear to linear-elongate, subirregularly to subdichotomously branched, 1.0-3.0 mm wide. *Upper surface* yellowish brown to reddish brown or dark brown, flat, smooth and shiny at the tips, becoming dull, lacking soredia and isidia; older lobes becoming rugose, cracked and areolate. Medulla white. *Lower surface* dull, slightly rugulose, black; rhizines moderately dense, simple or fasciculate, to 1.0 mm long, black. *Apothecia* scattered, sessile, to 1-3 mm wide; disc concave becoming ±flat, dark reddish brown to black-brown; thalline exciple thin, margin entire. Ascospores ellipsoidal, 8-10 x 5-6 µm. *Pycnidia* numerous, immersed. Conidia bifusiform, 5-8 x 1 µm.

Chemistry. Cortex K-, HNO_3+ dark blue-green; medulla K-, C-, KC-, P-; containing decarboxystenosporic acid (major), decarboxyanziaic acid (major), decarboxydivaricatic acid (trace), four unknowns (major).

This new species is a member of the *Neofuscelia pulla* (Ach.) Essl. complex characterized by foliose thalli with variable morphology, a black lower surface and the lack of isidia (Esslinger 1977, Elix 1995). *N. depsidella* is characterized by the loosely to moderately adnate thallus and a chemosyndrome of unique depsides in the medulla. This chemosyndrome contains at least seven new depsides in substantial quantities, the structures of which appears to be based on that of decarboxystenosporic acid. The structural elucidation of these substances is beyond the scope of the present work and will be reported separately (Elix & Wardlaw, in sched.). *N. depsidella* appears to be confined to Central Otago in the South Island of New Zealand.

Specimen Examined

NEW ZEALAND. South Island, Otago, Crown Range, 28 km ENE of Queenstown, 1000 m, on exposed rock in tussock grassland, *J. A. Elix 9869,* 4.i.1982 (CANB).

Neofuscelia olivetorica Elix, sp. nov. Fig. 6

Species cum thallo ut in *Neofuscelia adpicta* sed ab hac specie lobis marginibus lobulatis et acido olivetorico continente differt.

Type: New Zealand. South Island, Canterbury, ridge to Nervous Knob, above Broken Creek ski field, Craigieburn Range, 43°03'S, 171°42'E, 1600 m, on exposed rock outcrop in alpine grassland with scattered low shrubs and greywacke outcrops, *J. Johnston 3026,* 4 Nov. 1989; holo: WELT.

Thallus foliose, tightly adnate, saxicolous, forming irregular rosettes, 3-6 cm wide. *Lobes* radiating, separate, elongate to linear-elongate, subdichotomously branched, 1-2 mm wide; usually wider at or near the apices, narrower within; margins lobulate. *Upper surface* dark brown to brown-black, slightly paler and red brown at the periphery, flat, the apices shiny, smooth or ±irregularly pitted, older lobes becoming dull, cracked and rugose; lacking soredia and isidia. Medulla white. *Lower surface* black, slightly paler at tips, flat; rhizines sparse to moderate, simple, to 0.3 mm long, black. *Apothecia* common, sessile, to 2 mm wide; disc shallowly concave to ±flat, black-brown; thalline exciple thin, margin entire. Ascospores ellipsoidal, 8.5-10.5 x 4-6 µm. *Pycnidia* common, immersed. Conidia bifusiform, 5.5-6.5 x 1 µm.

Chemistry. Cortex K-, HNO_3+ dark blue-green; medulla K-, C+ red, P-; containing olivetoric acid (major), 4-*O*-demethylmicrophyllinic acid (trace).

Morphologically this species resembles *Neofuscelia adpicta* (Zahlbr.) Essl. and *N. plana* (Essl.) Essl. as all three have stellate, tightly adnate thalli with flat lobes which are wider at the apices than centrally. Although *N. olivetorica* differs in having marginal lobulae, these species can best be distinguished chemically since *N. adpicta* contains divaricatic acid, *N. plana* glomelliferic acid and *N. olivetorica,* olivetoric acid. The only other species of *Neofuscelia* with a black lower surface which lacks isidia but contains olivetoric acid is *N. cafferensis* (Essl.) Essl. from South Africa. However, the thallus of this species is moderately to loosely adnate or pulvinate, with strongly imbricated or entangled, short, broad lobes whereas the thallus of *N. olivetorica* is tightly adnate with elongated, separate lobes. Currently this rare endemic species is only known from the type locality.

Xanthoparmelia convolutella Elix sp. nov. Fig. 7

Species cum thallo ut in *Xanthoparmelia terrestris* sed ab hac specie saxicolo, lobis adnato et norlobaridono et loxodino continente differt. *Type*: Australia. Western Australia. Gairdner River, South Coast Highway, 5 km ENE of Jerramungup, 33°15'S, 118°58'E, 260 m, on granite rocks in cleared rocky paddock with small scattered trees, *J. A. Elix 41538*, 18 Sept. 1994; holo: CANB.

Thallus foliose, saxicolous, moderately to loosely adnate, 6-10 cm wide. *Lobes* imbricate, more or less flat to convex, irregularly branched, 1-2 mm wide; often with dense laciniae growing over the primary lobes, laciniae imbricate or entangled, subpulvinate, revolute to convolute, elongate, subdichotomously branched, 0.3-0.5(-1.0) mm wide, occasionally becoming subterete. *Upper surface* pale yellow-green, flat to convex, shiny but becoming dull and darkening with age, smooth to slightly rugulose, lacking maculae, soredia and isidia. Medulla white. *Lower surface* ivory to light brown, darker at apices; rhizines sparse to moderately dense, simple, concolorous. *Apothecia* not seen. *Pycnidia* common; conidia bifusiform, 5-6 x 0.5 µm.

Chemistry: Cortex K-; medulla K-, C-, KC+ rose, P-; containing usnic acid (major), norlobaridone (major), loxodin (minor).

Morphologically this new species resembles *Xanthoparmelia terrestris* (Kurok. & Filson) Elix & J.Johnst. since both are characterized by moderately to loosely adnate thalli and elongate, entangled, revolute lobes with a pale lower surface. However, *X. terrestris* is a terricolous species which contains medullary norstictic and salazinic acids whereas *X. convolutella* is a saxicolous species which contains loxodin and norlobaridone. *X.*

convolutella could be confused with *X. incrustata* (Kurok. & Filson) Elix & J.Johnst. since they have identical chemistry and both develop convex lobes and/or laciniae. However, *X. incrustata* is characterized by broad, adnate primary lobes which become distinctly rugulose and ±areolate, in contrast to the linear-elongate, convex marginal lobes and sparse laciniae, whereas *X. convolutella* has moderately to loosely adnate primary lobes and dense laciniae which commonly become entangled, subpulvinate, and distinctly revolute, convolute or subterete. *X. convolutella* appears to be confined to south western Western Australia, where it occurs on scattered granite inselbergs.

Specimens Examined

WESTERN AUSTRALIA. Boyagin Rock, Boyagin Nature Reserve, 20 km NW of Pingelly, 32°28'S, 116°53'E, 350 m, on large exposed granite outcrops, *J. A. Elix 41000, H. T. Lumbsch & H. Streimann,* 11.ix.1994 (CANB); Yilliminning Rock, 18 km NE of Narrogin, 32°57'S, 117°22'E, 320 m, on large exposed granite outcrop, *J. A. Elix 41044, H. T. Lumbsch & H. Streimann,* 11.ix.1994 (CANB).

Xanthoparmelia orchardii Elix sp. nov. Fig. 8

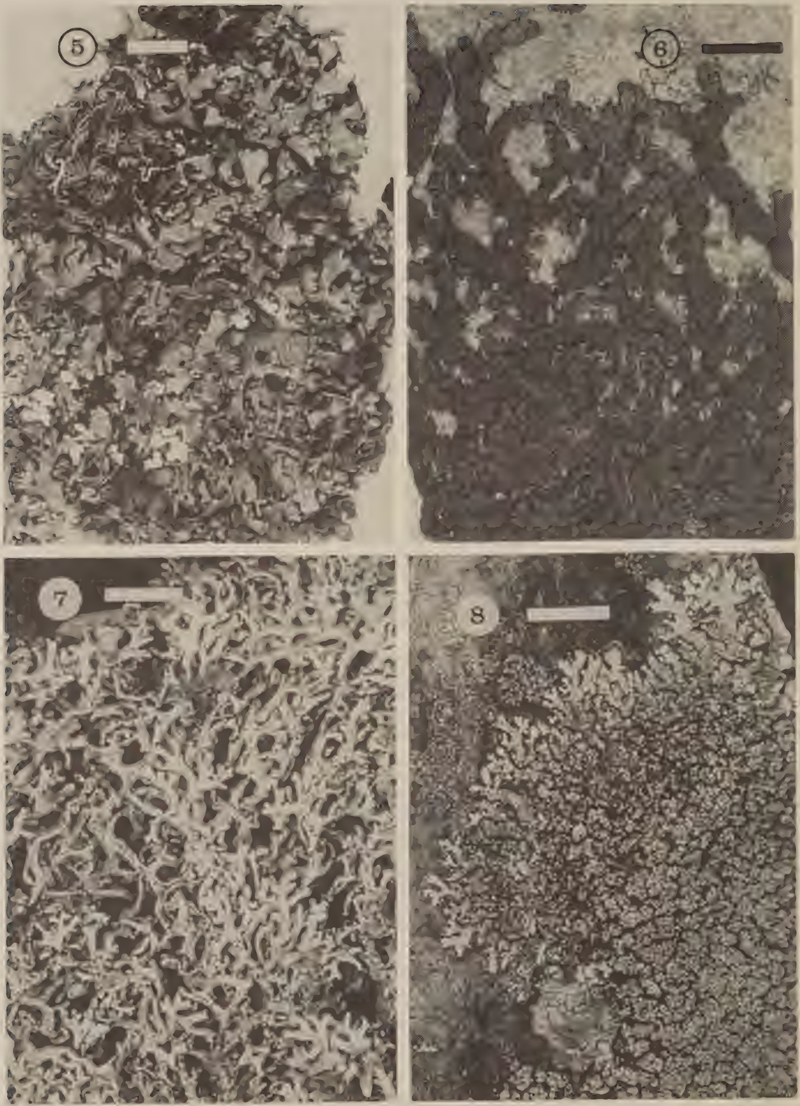
Species cum thallo ut in *Xanthoparmelia exillima* sed ab hac specie isidiis epicorticatis, inflatis et erumpentibus differt.

Type: Australia. Queensland. Pine Mountain, 24 km NE of Rockhampton, 23°11'S, 150°37'E, 240 m, on volcanic rocks in monsoon forest with emergent *Araucaria cunninghamii*, *J. A. Elix 34723*, 26 Aug. 1993; holo: CANB.

Thallus small-foliose to subcrustose, saxicolous, tightly adnate, 2-7 cm wide. *Lobes* congested, subirregular to sublinear-elongate, subdichotomously branched, 0.3-0.7(-1.0) mm wide. *Upper surface* yellow-green, darkening with age, flat, emaculate, commonly areolate towards thallus centre, lacking soredia; isidia cylindrical, simple or commonly branched, to 1.0 mm high, ±forming a dense mat in the thallus centre; isidia apices epicorticate, inflated but rarely erumpent, not sorediose. Medulla white. *Lower surface* flat, pale brown to dark brown; rhizines sparse, simple, concolorous. *Apothecia* rare, sessile, 1-2 mm in wide; disc concave, dark brown; thalline exciple densely isidiate. Ascospores ellipsoidal, 7-9 x 4-5 µm. *Pycnidia* not seen.

Chemistry: Cortex K-; medulla K-, C-, KC+ rose, P-; containing usnic acid (major), norlobaridone (major), loxodin (minor).

Previously this species has been confused with *Xanthoparmelia exillima* (Elix) Elix & J. Johnst. since both are characterized by tightly adnate, small-



Figures 5-8. New species of Parmeliaceae: 5, *Neofuscelia depsidella* (holotype in WELT); 6, *Neofuscelia olivetorica* (holotype in WELT); 7, *Xanthoparmelia convolutella* (holotype in CANB); 8, *Xanthoparmelia orchardii* (holotype in CANB). Scale bar = 5 mm.

foliose to subcrustose thalli with an isidiate upper surface, a pale lower surface and the presence of medullary norlobaridone. However they can clearly be separated by the nature of the isidia - the apices being syncorticate, noninflated, intact and often dark or blackened in *X. exillima* but being epicorticate, commonly inflated and occasionally bursting open in *X. orchardii.* The two species also differ in their minor chemical constituents; *X. orchardii* containing loxodin in addition to usnic acid and norlobaridone, while *X. exillima* lacks loxodin but contains a minor unknown which is slightly more polar than norlobaridone. *X. orchardii* appears to be confined to central and northern Queensland. *X. exillima* is a more common and widely distributed species in southern and eastern Australia. This new species is named in honour of the Australian botanist and Executive Editor of the *Flora of Australia* Dr. Anthony (Tony) E. Orchard.

Specimens Examined

QUEENSLAND. Red Falls Road, 37 km NW of Charters Towers, 19°53'S, 145°59'E, 280 m, on basalt rocks in *Eucalyptus* woodland, *J. A. Elix 20531 & H. Streimann*, 21.vi.1986 (CANB); Mt. Leyshon, 24 km S of Charters Towers, 20°18'S, 146°16'E, 400 m, on volcanic rocks in abandoned mining settlement, *J. A. Elix 20548 & H. Streimann*, 22.vi.1986 (CANB).

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LITERATURE CITED

Culberson, C. F. (1972). Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journal of Chromatography* **72**: 113-125.

Culberson, C. F., Culberson, W. L. and Johnson, A. (1981). A standardized TLC analysis of β-orcinol depsidones. *Bryologist* **84**: 16-29.

Culberson, C. F. and Johnson, A. (1982). Substitution of methyl *tert.*-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *Journal of Chromatography* **238**: 483-487.

Elix, J. A. (1994). Parmeliaceae. *Flora of Australia* **55**: 1-312.

Elix, J. A. (1995). New species in the lichen family Parmeliaceae (Ascomycotina) from Australasia and Malaysia. *Mycotaxon* **56**: 231-241.

Elix, J. A. (1996). New species in the lichen family Parmeliaceae (Ascomycotina) from Australasia and Oceania. *Mycotaxon* **59**: 407-417.

Elix, J. A., and Ernst-Russell, K. D. (1993). *A Catalogue of Standardized Thin Layer Chromatographic Data and Biosynthetic Relationships for Lichen Substances,* 2nd Edn. (Australian National University, Canberra).

Elix, J. A., Johnston, J. and Parker, J. L. (1988). A Computer Program for the Rapid Identification of Lichen Substances. *Mycotaxon* **31**: 89-99.

Feige, G. B., Lumbsch, H. T., Huneck, S. & Elix, J. A. (1993) The identification of lichen substances by a standardized high-performance liquid chromatographic method. *Journal of Chromatography* **646**: 417-427.

Galloway, D. J. (1996a). Brain Laurence Enting. *Australasian Lichenological Newsletter* **39**: 4-6.

Galloway, D. J. (1996b). Margaret Jane Annand Bulfin. *Australasian Lichenological Newsletter* **39**: 6-9.

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INGOLDIAN FUNGI FROM THE CATALAN PYRENEES: PURE CULTURE STUDIES

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Summary:

Descriptions based on monoconidial cultures are provided for 33 taxa of Ingoldian fungi ("aquatic hyphomycetes") isolated in November 1995 from fast-flowing streams in the Catalan Pyrenees. Some isolates of doubtful identity are discussed under Anguillospora, Tricellula, Tricladium, Tridentaria and Triscelophorus.

The species list reported by Descals & Moya (in press) from parallel foam samples is extended.

The presence of Anguillospora furtiva sp. ined., Arbusculina moniliformis, Heliscina antennata, H. cf. campanulata, Isthmolongispora minima, Sigmoidea aurantiaca, Stenocladiella neglecta, Tricellula aquatica, Tricladium curvisporum, Tumularia tuberculata and Varicosporium delicatum is first confirmed through pure culture for the Iberian peninsula. Dendrospora polymorpha is illustrated with a wider, more typical, range of conidial form than was previously known in culture. Mycocentrospora sp. and the anamorphic basidiomycete Titaeella cf. capnophila, not vommon in streams and thus believed to inhabit aerial parts of plants, are discussed. Conidia of Lemonniera filiformis, often difficult to distinguish in foam or membrane filters from similar species, are illustrated.

Keywords: hyphomycetes, ascomycetes, basidiomycetes, freshwater, taxonomy, distribution, Spain.

Introduction:

Descals & Moya (in press) published recent records of fungi found as conidia in scum off fast-flowing streams in the Catalan Pyrenees. This paper confirms through pure culture the presence of a number of species with less diagnostic conidia (e.g. scolecosporous forms, the Alatospora acuminata complex, some Lemonniera spp., etc), and provides information for the characterization of lesser known species, some of which may be new to science.

Materials and Methods:

Sites appearing under Results were described more precisely in Descals & Moya (in press), except the

following:
L3: frozen scum from R. Ter, running through conifers and highland meadows, at Vallter ski resort, Cerdanya, E. Descals, 8 Nov. 1995.
L7: scum from small, undisturbed, cascading stream running through mixed deciduous wood, right tributary of R. Freser, ca. 1 Km from Campelles, on road to Ribes, Ripollés, E. Descals, 10 Nov. 1995.
L10: scum from R. Aiguamòg, large stream on south slope of Aran Valley, above reservoir, running through mixed conifer (incl. Juniperus) and deciduous woods, E. Descals, 11 Nov. 1995.
L21: (same site as L14 but different date): scum from Arriu dera Soberpèra, small, cascading stream running through rich, undisturbed, mixed deciduous woodland, above Les, Aran Valley, E. Descals, 13Nov. 1995.

General techniques used for foam collection, monoconidial isolation, culture, sporulation and herbarium preparation are detailed in Descals & Díaz (in prep.).

For this particular study, isolates were grown on 0.1% MA (malt extract agar) and incubated in sealed polythene Petri dishes in diffuse daylight at room temperature. Unless otherwise stated, conidial production in all cases was induced by placing portions of colonies in sterile distilled water in polythene Petri dishes and incubated in an isothermic room at 15°C in diffuse white light. Incubation times depended on the species and, if sporulation failed or was poor, the water cultures were submitted to a further NUV treatment (8/16 h photoperiod) in the same room.

Collections, with numbers preceded by L, are kept as microscope preparations and dried cultures in Herb. Descals.

Results

With regard to vegetative characters as affected by growth conditions, the use of 0.1% MA has mostly resulted in pale, glabrous colonies, which are by far not as diagnostic as on 2% MA, where pigmentation is significantly more intense and characteristic. On this medium, however, sporulation is as a rule much poorer.

Although experimental controls were not run, it is most likely that NUV irradiation had a positive effect on sporulation of a significant proportion of the submerged isolates.

TAXONOMIC PART

1- Alatospora acuminata Ingold 1942

Hyphomycetes. COLONY white, with tenuous concentric rings of denser mycelium, glabrous; attaining 20 mm diam. in 21-30 days, depending on the isolate. SPORULATION undetected after 6 days in contact with water, but abundant after 7 or more days under NUV, superficial or underwater. CONIDIA mostly one-armed.

MATERIAL EXAMINED: L7A3, L7A19, L7A20: stream below Campelles, Ripollés, E. Descals, 10 Nov. 1995; L14A13: Arriu dera Soberpèra, above Les, Aran Valley, 12 Nov. 1995.

For a discussion of morphological plasticity in this species and other similar ones in *Alatospora* see Marvanová & Descals (1985).

2- *Anguillospora crassa* Ingold 1958

Ascomycete anamorph. COLONY grey, aerial mycelium very low, sparse; attaining 19-22 mm diam. in ca. 15 days to 30 mm diam. in 19 days, depending on isolates. SPORULATION sparse to abundant after 6 days in contact with water, submerged or superficial.

MATERIAL EXAMINED: L5A22: R. Ter, above Setcases, Cerdanya, E. Descals, 8 Nov. 1995; L16A6: Gotèr de Serracorba, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995; L21A1: Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 13 Nov. 1995.

3- *Anguillospora furtiva sp. ined.*

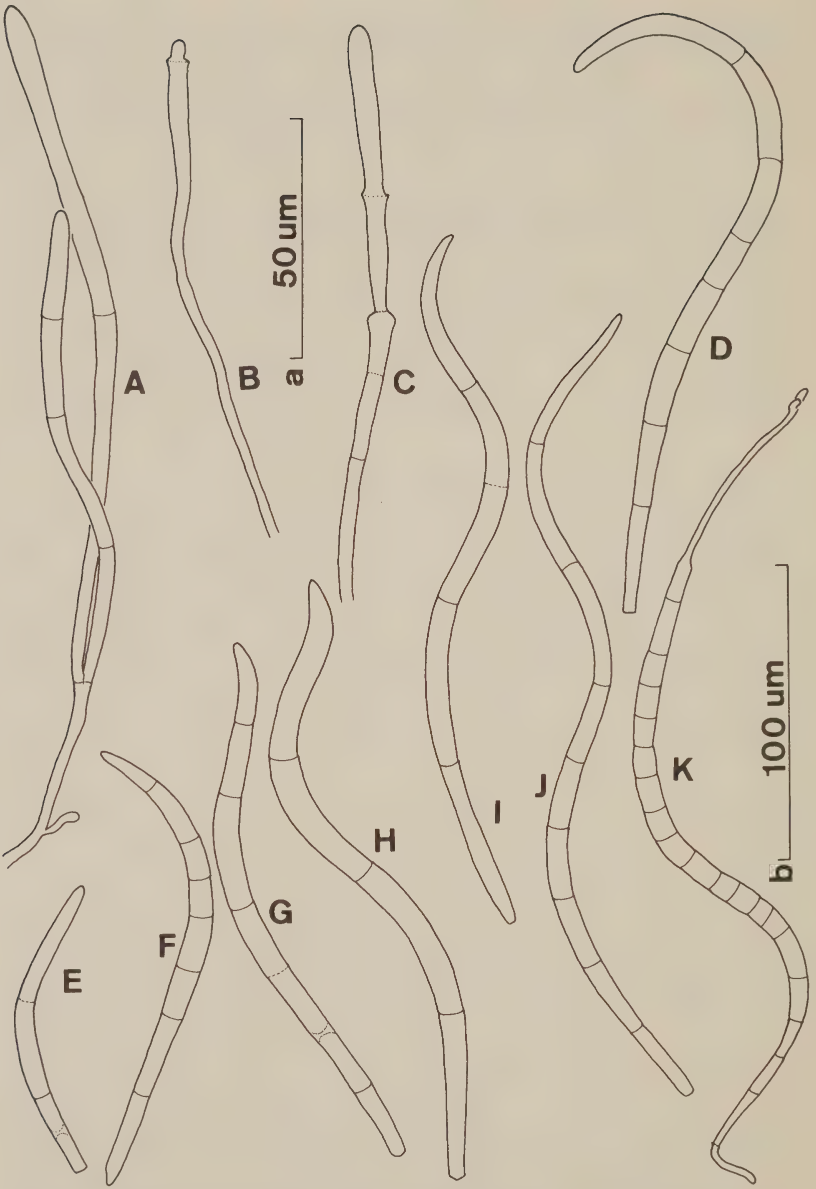
Fig. 1

Ascomycete anamorph. COLONY whitish, centre grey, margin diffuse, aerial mycelium sparse, forming a concentric ring; attaining 18 mm diam. in 36 days. SPORULATION present after 6 days in contact with water, but more abundant after a further 6 days. CONIDIOPHORES hyaline, solitary, apical, semimacronematous, simple or sparsely branched, septate. CONIDIOGENOUS CELLS solitary, terminal, integrated, monoblastic, scar broad; proliferations percurrent. CONIDIA hyaline, solitary, terminal, integrated with the conidiophore, long-fusoid, sometimes with one or more intercalary constrictions, curvate or more often sinuous in more than one plane, (100-)150-290 x 6.5-9 um, multiseptate, base truncate to short-conical. Secession schizolytic.

MATERIAL EXAMINED: L14A21, Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

This species was first described and illustrated in Webster & Descals (1981) as the anamorph of a *Pezoloma* (Leotiales), a terrestrial discomycete well known to Korf (*in litt*.) and which he suspected had already been described in the early literature. A formal description will appear in Descals *et al.* (in prep.). Conidia are found in scum from various streams in Great Britain.

This is the first record of the anamorph proven through pure culture for the Iberian Peninsula. Pure culture confirmation is particularly valuable in this case, as the conidia can be easily confused with those of *A. longissima* (the anamorph of a bitunicate ascomycete) or even in some cases with those of *A. crassa* Ingold and *A. fustiformis* sp. ined. (Marvanová *et al*. in press). In the parallel foam sampling done by Descals & Moya (in press), *A. furtiva* was recorded from seven sites, in the Aran and R. Ter Valleys.


A
B
a
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C
D
E
F
G
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I
J
K
100 um
b

Fig. 1. Anguillospora furtiva sp. ined. (from L14A21). A-C. Conidial development. Remaining: conidia. K. Conidium displaying bipolar germination. Scale bars: a 50 um, b 100 um.

4- Anguillospora longissima (Sacc. et Sydow) Ingold 1942
Ascomycete anamorph. COLONY white with dark grey concentric rings, glabrous; attaining 25 mm diam. in 14 days or 36 mm in 16 days, depending on isolates. SPORULATION abundant within 4 days in contact with water, superficial or underwater.

MATERIAL EXAMINED: L7A15; L21A3: Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 13 Nov. 1995.

In Descals & Moya (in press), A. longissima had only been recorded in foam of L2, most probably because conidia of this species were very sparse in the other samples.

5- Anguillospora sp. 1

Figs. 2,3

Hyphomycetes. COLONY dark grey, margin entire, lobed; aerial mycelium very sparse; attaining 7 mm diam. in 1 month (L1A8). SPORULATION superficial on partly submerged mycelium after 10 days in water. CONIDIOPHORES hyaline, micronematous to semimacronematous, and then lateral, single, unbranched. CONIDIOGENOUS CELLS solitary, integrated or discrete, terminal, lateral or intercalary, up to 30 x 1-3 um, monoblastic, scars broad, flat to subconvex; proliferations percurrent with nodose scars, or sympodial. CONIDIA hyaline, solitary, terminal, integrated with the conidiophore, long-cylindrical to subfusiform, straight, slightly curvate or somewhat sinuous, (40-)90-120(-160) x 3-4 um, obscurely multiseptate, base truncate to subconvex, sometimes widened, apex rounded. Secession schizolytic.

MATERIAL EXAMINED: L1A8, L1A14: stream below Castell de Requesens, Empordà, E.Descals, 7 Nov. 1995.

These isolates, which are no doubt conspecific, seem to fit within the generic complex Anguillospora-Mycocentrospora-Pseudoanguillospora. This is presently under revision. There is no resemblance to any known species of Anguillospora, but there is however to Mycocentrospora varians Sinclair et Morgan-Jones (a rather untypical Mycocentrospora). Both taxa produce grey colonies on 0.1% MA, and morphologically plastic conidiogenous structures, i.e.: conidiophores are mostly lateral and unbranched, with more or less integrated conidiogenous cells bearing truncate, unthickened scars and proliferating progressively in a poorly defined way. Conidia are slender and more or less cylindrical, typically subcurvate and multiseptate, with a rounded apex and truncate base. On the other hand, although their dimensions (especially length) are highly variable, in M. varians they are reported as 25-88 x 1-1.5 um, while in our isolates they range from 40 to 160 x 2.5-4 um, with an average length of ca. 100 um. The excentric parabasal appendage reported for M. varians, which has not been seen in our isolates, occurs probably too rarely to be of diagnostic value. This species reportedly grows much faster, reaching over 40 mm diam. in

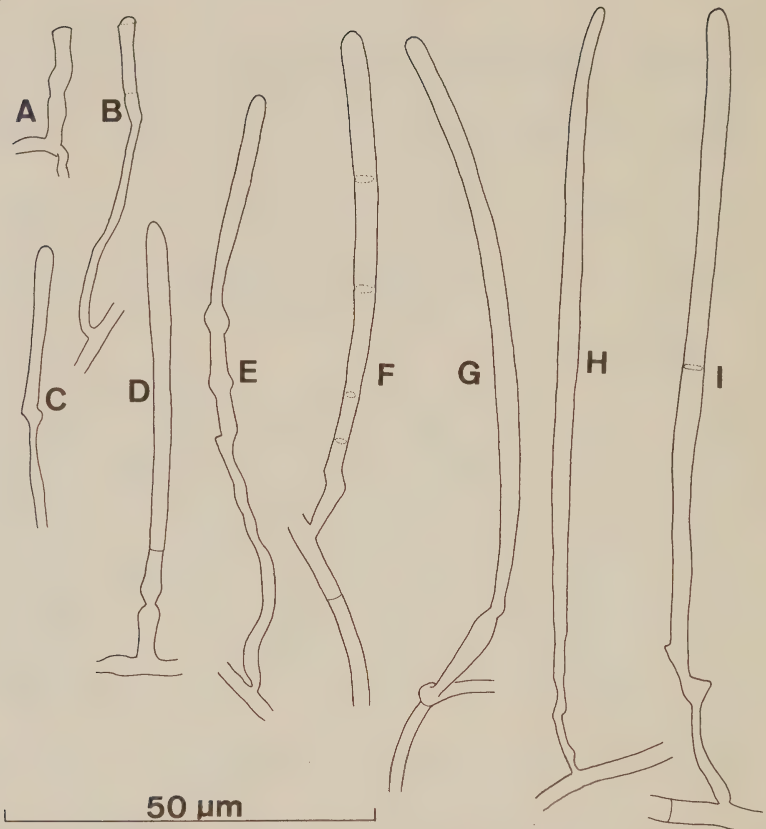


Fig. 2. Anguillospora sp. 1 (from L1A8). A-I. Conidial development. Scale bar: 50 um.

2 weeks at 15°C, although this is on 2% MA. M. varians is known to occur with certainty only in the American continent. There appear to be thus several good reasons for leaving the present isolates unnamed.

6- Anguillospora sp. 2

Figs. 4,5

Hyphomycetes. COLONY dark grey in centre, paling centrifugally, margin diffuse, aerial mycelium very sparse, towards the centre; attaining 2.2 cm diam. in ca. 3 weeks. SPORULATION sparse after 12 days in water, more abundant after a further 10 days, superficial on partly submerged mycelium. CONIDIOPHORES hyaline, typically semimacronematous, solitary, terminal or lateral, up to 7 um wide, simple or sparsely branched. CONIDIOGENOUS CELLS solitary, terminal, integrated, monoblastic, scars broad; proliferations percurrent or sometimes sympodial. CONIDIA

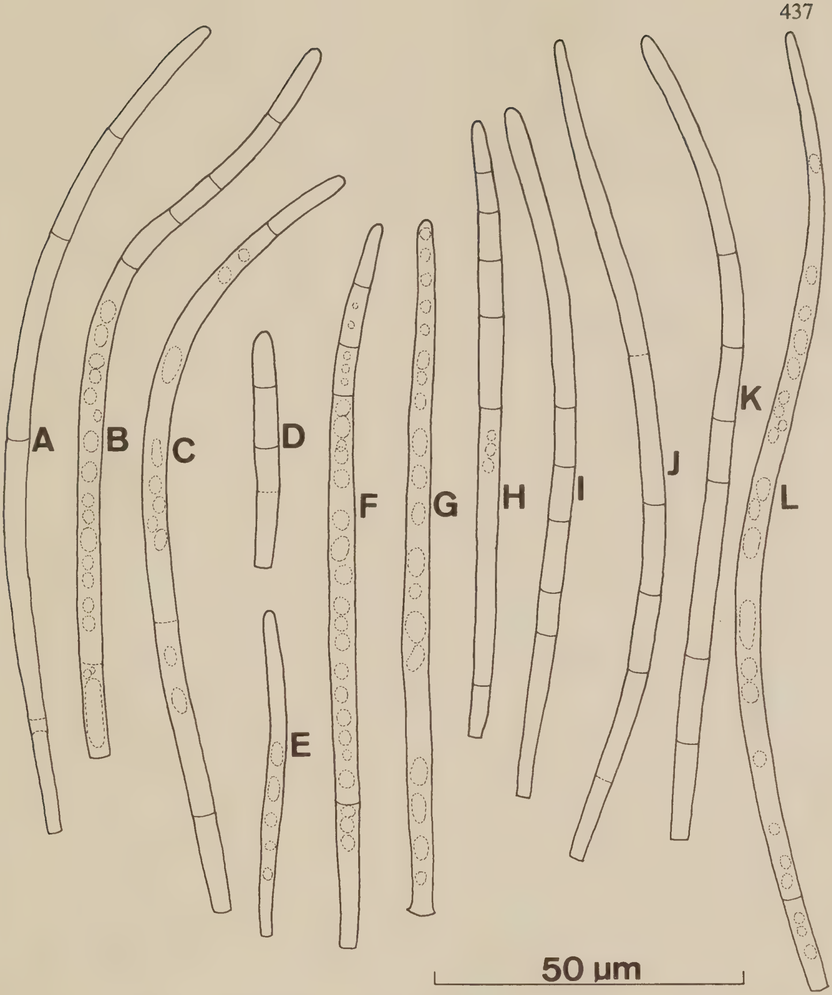


Fig. 3. Anguillospora sp. 1 (from L1A8). Conidia. Scale bar: 50 μm.

hyaline, solitary, terminal, cylindrical to long-navicular, mostly straight to subcurved, apex rounded, base truncate to convex, 45-160 x 8-12 um, multiseptate, eventually with frequent secondary septation, cells often subinflated. Secession schizolytic.

MICROCONIDIAL STATE hyphomycetous. CONIDIOPHORES hyaline, developing as small tufts at the poles of detached macroconidia, branched, up to 45 um in span. CONIDIOGENOUS CELLS solitary or grouped, terminal or sometimes lateral, discrete, lageniform, phialidic, main body 9-20 x 3-5 um;

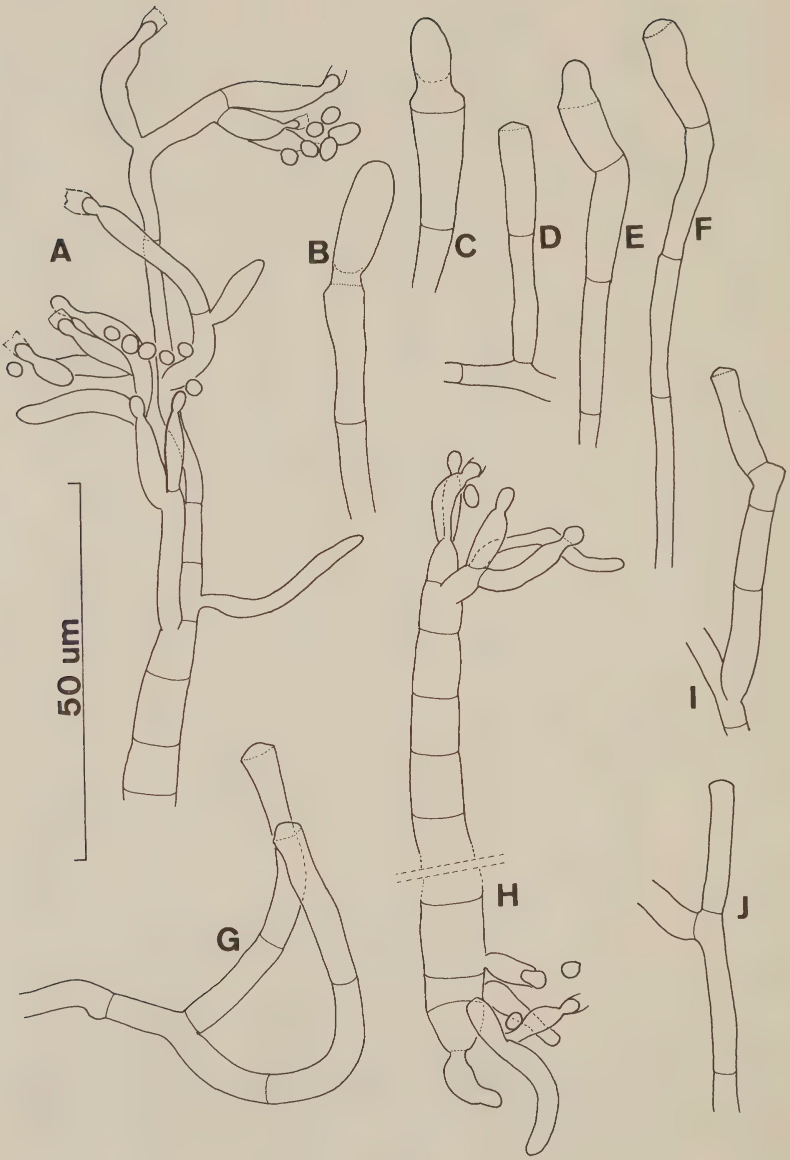
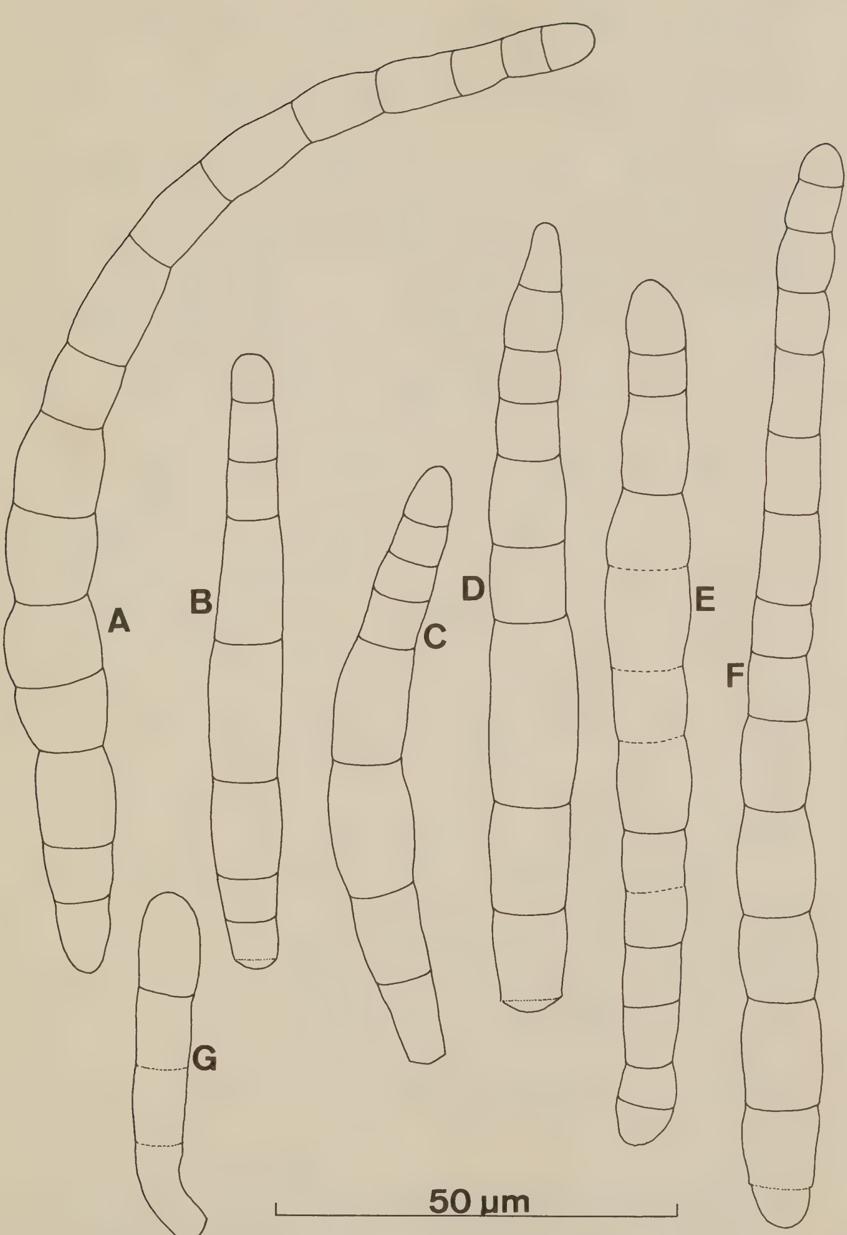


Fig. 4. Anguillospora sp. 2 (from L17A2). A, H. Microconidial state developing on macroconidial ends. Remaining: macroconidiophores. B, C, I. Proliferation, which is percurrent or sometimes sympodial Scale bar: 50 μm.


A
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50 µm

Fig. 5. Anguillospora sp.2 (from L17A2). Conidia. Scale bar: 50 μm.

collarette cupulate, up to 3 x 3 um. CONIDIA hyaline, ellipsoid, ovate, subturbinate or globose, 2.5-3.5 x 2.5 um. Germination not seen.

MATERIAL EXAMINED: L17A2: stream in Barranc deth Cap deth Pish, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

This isolate resembles the poorly known Mycocentrospora clavata Iqbal, where conidial dimensions are reportedly (34-)55-88 X (7-) 10(-13) um. Some of the long, straight conidia resemble those of Anguillospora fustiformis Marvanová, and more curved ones look like those of Anguillospora crassa Ingold, but they are on the whole much shorter. In the latter species, conidia are (75-)110-230(-550) um long. Some terrestrial species of Mycocentrospora have similar conidia, but the conidiophores are very different, showing sympodial proliferation and prominent scars. It is preferred to leave this isolate unnamed until more material from the same site is studied.

7- Arbusculina moniliformis (Descals) Marvanová et Descals 1987

Hyphomycetes. COLONY with radially alternating grey and whitish patches, margin diffuse, aerial mycelium very sparse; attaining 26 mm diam. after 18 days. SPORULATION detected after 5 days in water, superficial. CONIDIOPHORES hyaline, solitary, terminal, semimacronematous, simple. CONIDIOGENOUS CELLS solitary, terminal, integrated, monoblastic, 2-3 um wide, scars broad. CONIDIA hyaline, solitary, terminal, branched; elements long-navicular to subfusoid, straight to subcurved, apices rounded, multiseptate, cells mostly inflated; axis 75-120(-155 when unbranched) x 9-13 um, scars broad, flat to convex; branches (0-) 1-3, solitary, lateral, closely sequential, up to 45 x 7-9 um. Secession schizolytic.

MATERIAL EXAMINED: L4A4: small tributary of R. Ter, Vallter, Cerdanya, E. Descals, 8 Nov. 1995.

A. moniliformis had not been recorded by Descals & Moya (in press) in parallel foam samples.

8- Articulospora tetracladia Ingold 1942

Ascomycete anamorph. COLONY white or pale beige with concentric pinkish zonations, glabrous; attaining 41 mm diam. in 16 days (L14A7). SPORULATION sparse after 2 days in water, but abundant after 6 days.

MATERIAL EXAMINED: L14A7: Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995; L16A1, L16A3: Gotèr de Serracorba, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

9- Clavariopsis aquatica De Wild. 1895

Ascomycete anamorph. COLONY diffuse, white, central area grey, aerial mycelium very sparse, low; attaining 37 mm

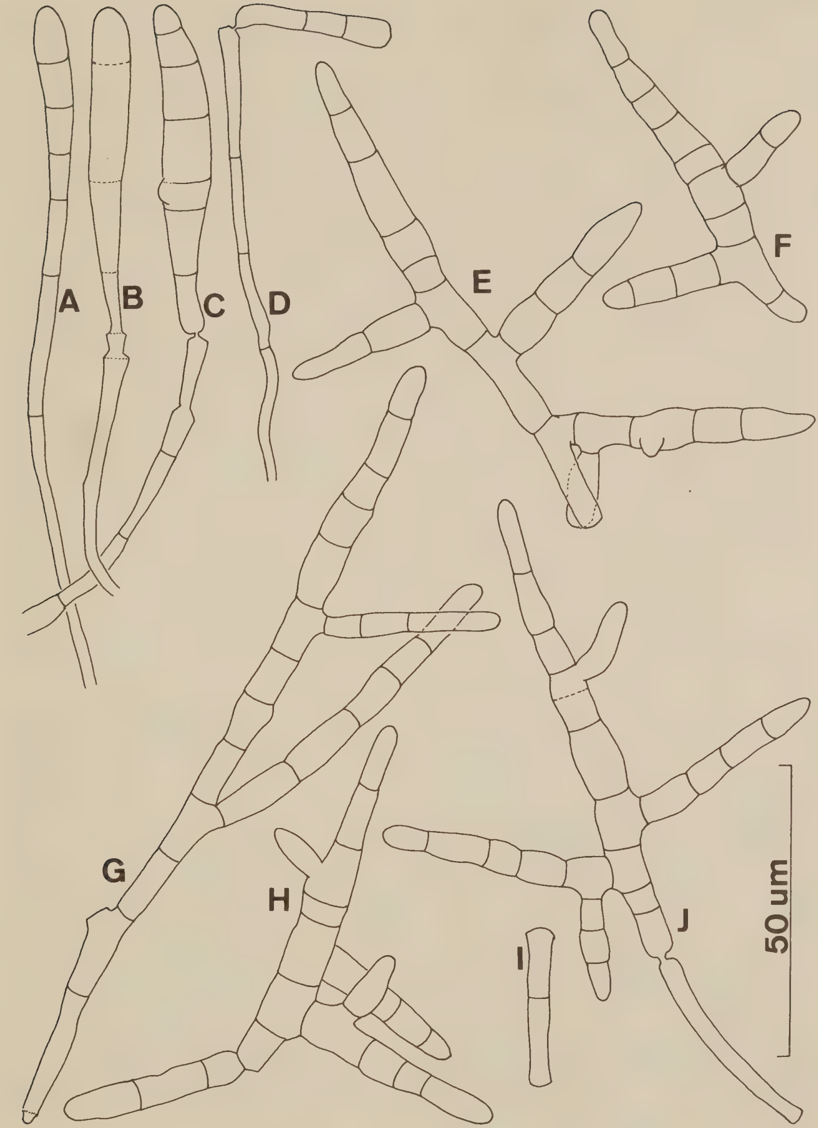


Fig. 6. Dendrospora polymorpha (A-D, F, H-J from L5A26; E from L5A7; G from L4A9). A-D. Conidiophores and conidial proliferation. Remaining: free conidia. G. Note scar left after conidial fragmentation. I. Part-conidium. J. Abnormal case of secession. Scale bar: 50 μm.

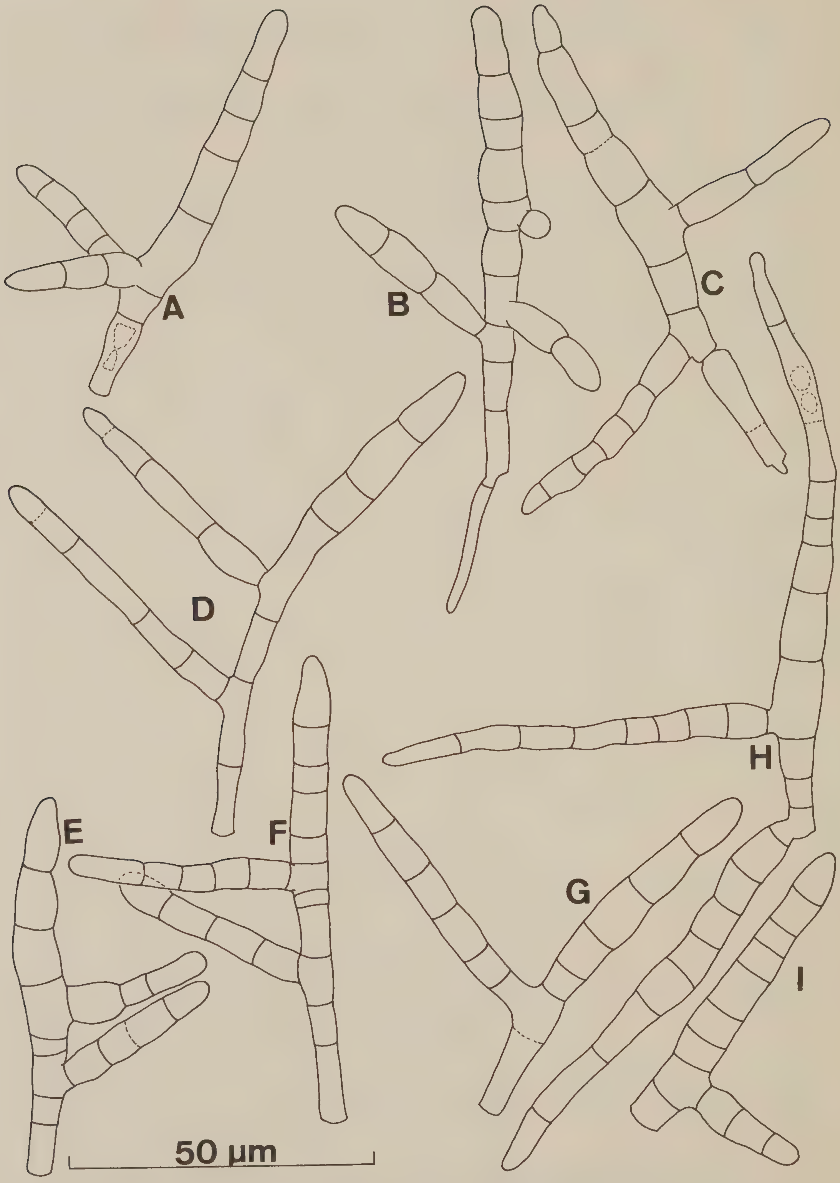


Fig. 7. Dendrospora polymorpha (A-C, E, H, I from L5A26; D, F, G from L4A9). Conidia. B. Germinating conidium. C. Conidium undergoing fragmentation. H. Conidium with frequently seen suprabasal branch. Scale bar: 50 µm.

diam. in 16 days. SPORULATION abundant within 4 days in water, submerged.

MATERIAL EXAMINED: L14A1: Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

10- Dendrospora polymorpha Roldán et Descals 1987

Figs. 6,7

Hyphomycetes. COLONY white, glabrous; attaining 23 mm diam. in 19 days (L4A9). SPORULATION abundant within 6 days in water, superficial and underwater, mostly from older portions of the colony. CONIDIOPHORES hyaline, solitary, terminal, semimacro- nematous, simple. CONIDIOGENOUS CELLS solitary, terminal, integrated, up to 4.5 um wide, monoblastic, scars broad, subconvex; proliferations percurrent, up to 15 um long. CONIDIA hyaline, solitary, terminal, branched in 1-2 orders, elements long-navicular to subfusoid, typically straight, or also subcurved or somewhat sinuous, apices rounded; multiseptate; axis 50-100(-140 when unbranched) x 4-8 um, scar flat or subconvex; branches solitary, (sometimes a lower pair subopposite, as in fig. 7B), lateral, sequential, one probably often suprabasal (see below) and retrorse; primary branches (0-)2(-3), up to ca. 65 um long, secondary branches 0(-2), slightly shorter than the primary. Secession schizolytic. Conidia often fragmenting with age near the base.

MATERIAL EXAMINED: L4A9: small, left tributary of R. Ter, Vallter, Cerdanya, E. Descals, 8 Nov. 1995; L5A7, L5A26: R. Ter, above Setcases, Cerdanya, E. Descals, 8 Nov. 1995.

This is undoubtedly the species described in Roldán et al. (1987). Although not emphasized, conidiogenous cell proliferation is seen as percurrent in several of their drawings. Because of the proclivity for conidial fragmentation, what is often seen as a parabasal appendage may really be the lowermost lateral after the lower axis has separated, because a parabasal appendage has not been seen on developing conidia. The poor branching described in the protologue may have been due to unsatisfactory environmental conditions, as the cultures were contaminated with bacteria.

With the present and other unpublished records, D. polymorpha may now be considered a widespread species on the Iberian peninsula.

Marvanová (in litt.) notes on the striking resemblance between D. polymorpha and her Pachycladina mutabilis, where subopposite conidial branching is frequent. Although not conspecific, they could probably be placed in the same genus.

11- Flagellospora curvula Ingold 1942

Hyphomycetes. COLONY white with radial streaks of denser mycelium, glabrous; attaining 33 mm diam. in 31 days (L1A13). SPORULATION abundant after 6-12 days in water, superficial and submerged, often on young mycelium produced after colony submersion.

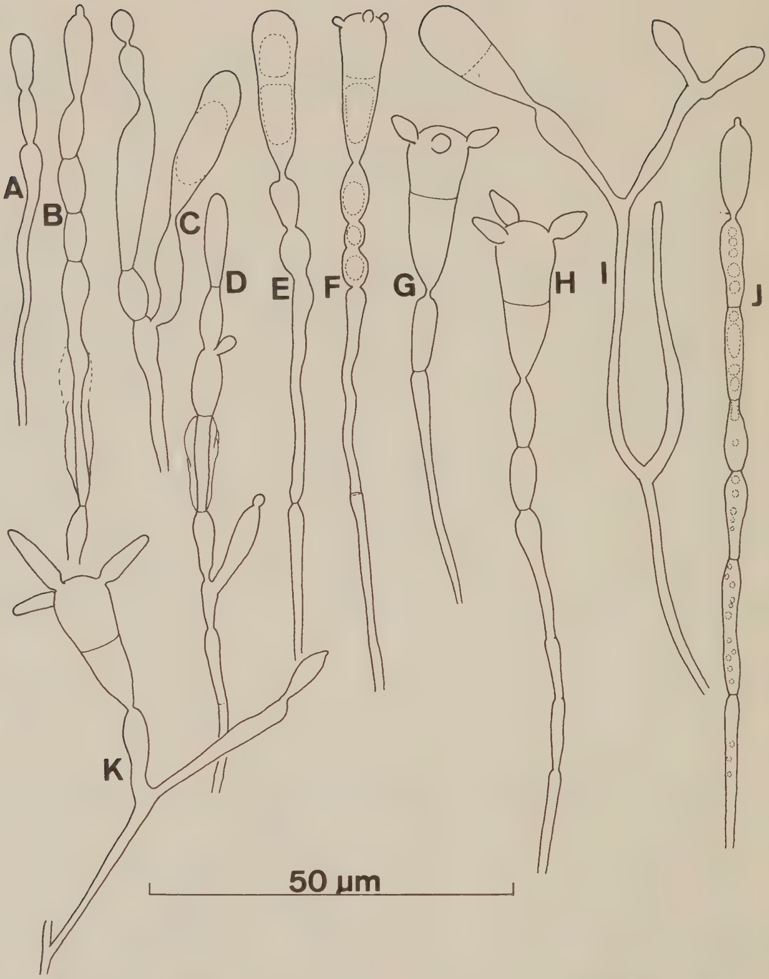


Fig. 8. Heliscina antennata (from L21A5). A-K. Conidiophores and conidial development. B, D. Probable examples of regeneration through a collapsed condiophore cell. C, I, K. Sparsely branched conidiophores. Scale bar: 50 µm.

MATERIAL EXAMINED: L1A13, stream below Castell de Requesens, Empordà, E. Descals, 7 Nov. 1995. L5A30: R. Ter, above Setcases, Cerdanya, E. Descals, 8 Nov. 1995.

12- Heliscina antennata Marvanová 1980

Figs. 8,9

Hyphomycetes. COLONY white, with some concentric zonations of denser mycelium, glabrous, margin diffuse; attaining 10 mm diam. in 27 days. SPORULATION abundant after 6 days in water, superficial and submerged. CONIDIOPHORES hyaline, solitary, terminal, semimacronematous, simple or sparsely

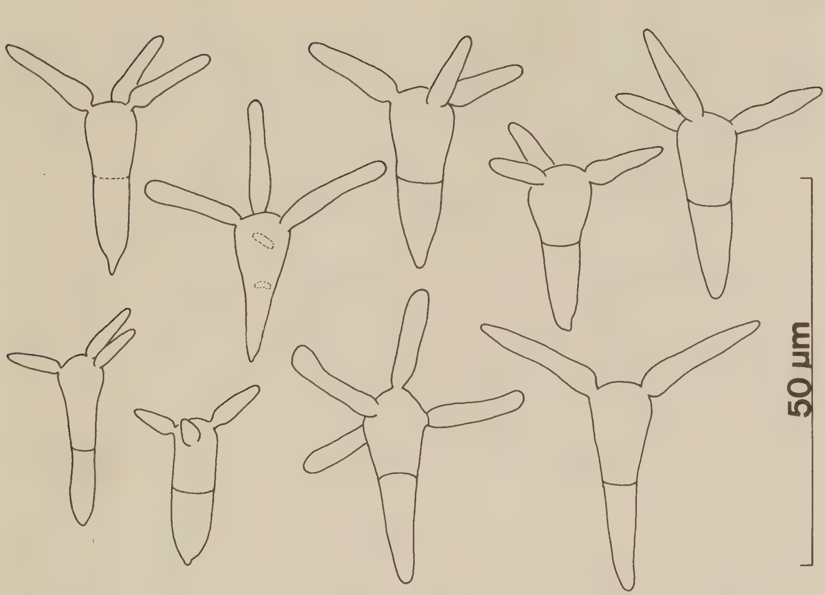


Fig. 9. **Heliscina antennata (from L21A5). Conidia. Scale bar:50 µm.**

branched, multiseptate. CONIDIOGENOUS CELLS solitary or sometimes paired, terminal or lateral, integrated or discrete, 2.5-3.5 um wide, monoblastic, scars narrow; proliferations percurrent, discrete, irregularly monilioid. CONIDIA hyaline, solitary, terminal, long-clavate with coronate projections; main body 19-30 x 6-9 um, (0-) 1 septate, scar apiculate, mucronate or indistinct; branches (2-) 3(-4), synchronous, mostly subulate, 5-17 x 1.5-3 um, apex rounded, insertion constricted. Secession schizolytic.

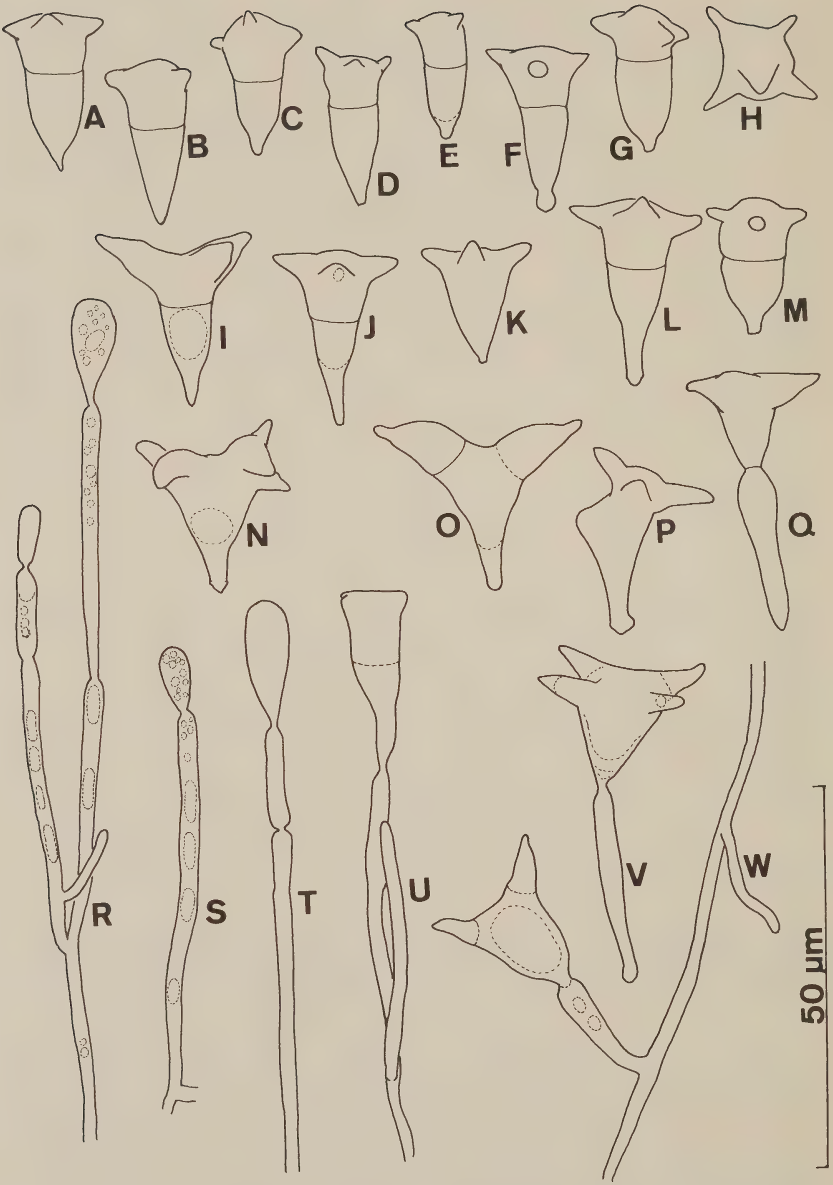
MATERIAL EXAMINED: L21A5: Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 13 Nov. 1995.

H. antennata was recorded from foam in the Aran Valley by Descals & Moya (in press, figs. 5A,B) as an unknown taxon similar to Heliscina Marvanová.

13- Heliscina cf.campanulata Marvanová 1980

Fig. 10

Hyphomycetes. COLONY white, centre dark grey, glabrous, margin diffuse; attaining 13 mm diam. in 27 days (L14A17). SPORULATION sparse after 6 days in water, but more abundant after 2 weeks, submerged. CONIDIOPHORES hyaline, micro- to semimacronematous, solitary, terminal or lateral, simple or sparsely branched, obscurely septate. CONIDIOGENOUS CELLS solitary, terminal (and integrated), or lateral, 2-4 um wide, monoblastic, scars indistinct; proliferations percurrent, discrete, long cylindrical to lageniform, up to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50 µm

Fig. 10. Heliscina campannulata (from L14A17). A-Q, V. Conidia. Top row depicts the more typical shapes. H. Bottom view of conidium. Remaining: conidiogenesis. Scale bar: 50 µm.

35 um long. CONIDIA hyaline, solitary, terminal, obcampanulate to clavate with coronate projections; main body 15-20 x 6-9 um, (0-)1 septate, scar typically mucronate; projections 3-4, synchronous, mammillate to conoid, up to 4 x 3.5 um. Misshapen conidia spanning up to 27 um, projections bifurcate or irregularly arranged. Secession schizolytic.

MATERIAL EXAMINED: L14A17, L14A23: Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

Conidia indistinguishable from those of _H. campanulata_ were recorded, albeit infrequently, in foams from two nearby streams in the same Les area of the Aran Valley (Descals & Moya in press). Those produced in the present isolates are of the same type, although, as remarked by Marvanová (_in litt_.), conidiogenesis does not quite match that described in the protologue, i.e. terminal conidiogenous cells are integrated onto the conidiophores, and only their proliferations are discrete. Further material should be studied from the site, for proof of conspecifity.

14- _Isthmolongispora minima_ Matsushima 1971

Fig. 11

Hyphomycetes. COLONY white with an outer concentric ring of denser mycelium, glabrous, margin dendroid; attaining 30 mm diam. in 30 days (L7A6). SPORULATION sparse after 6 days in water, but abundant after a further 10 days.

MACROCONIDIAL STATE: CONIDIOPHORES hyaline, solitary or grouped, lateral, semimacronematous to micronematous, simple to sparsely branched, 2-2.5 um wide. CONIDIOGENOUS CELLS single or grouped, terminal and integrated, or lateral, 6-23 x 1.5-2.5 um, polyblastic, scars denticulate; proliferations sympodial. CONIDIA hyaline, solitary, terminal, 25-36(-46) x 2.5-3 um wide; elements two, superposed, 0-septate, sequential, separated by an abrupt isthmus; basal element long-clavate, scar mostly distinct; apical element long-obclavate, apex acute to subacute. Secession schizolytic.

MICROCONIDIAL STATE (L7A6): CONIDIOGENOUS CELLS are macroconidial elements, scars apical or lateral, flat or denticulate, periclinal thickenings not evident; proliferations not seen. CONIDIA hyaline, ellipsoid, 4-5 x 1.5-2.5 um. Secession schizolytic. Germination not seen.

MATERIAL EXAMINED: L20A10: small, unnamed left-hand tributary of R. Joeu, Artiga de Lin, Aran Valley, E. Descals, 13 Nov. 1995; L7A4, L7A6, L7A7: unnamed stream below Campelles, Ripollés, E. Descals, 10 Nov. 1995.

I. minima was not recorded as conidia from the same Pyrenean foams by Descals & Moya (in press). This is the first report of its microconidial state. At first sight it is _Acremonium_-like, but, from the sparse material

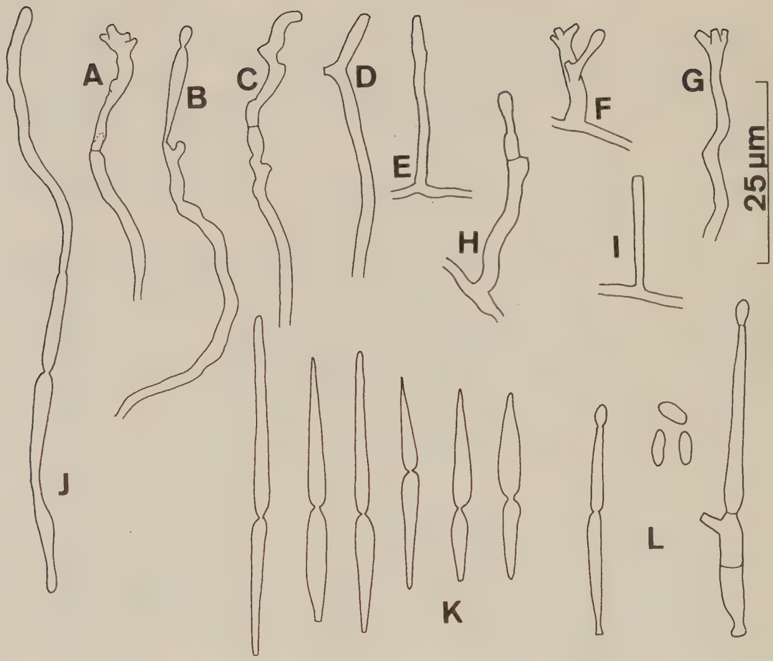

Fig. 11. Isthmolongispora minima (from L7A6). A-I. Conidiophores. J. Conidial germination. K. Six conidia (correct orientation doubtful). L. Microconidial state developing directly on macroconidia. Scale bar: 25 μm.

available, the presence or mode of conidiogenous cell proliferation could not be ascertained. A raised, flat scar is obvious in fig. 11L and there is no evidence of periclinal thickenings or collarettes. If phialides are thus not the case, this would be an unusual feature among the microconidial states of Ingoldian fungi.

15- Lemonniera cornuta Ranzoni 1953

Hyphomycetes. COLONY pale reddish brown, glabrous; attaining ca. 30 mm diam. in 12 days (L1A5). Sclerotia scattered or as an outer concentric ring, black, under 1 mm wide. SPORULATION abundant after 7 days in water, submerged. CONIDIA producing hyphopodia upon germination.

MATERIAL EXAMINED: L1A5, L1A7, L1A11: stream below Castell de Requesens, Empordà, E. Descals, 7 Nov. 1995.

16- Lemonniera filiformis R.H. Petersen ex Dyko 1977

Fig. 12

Hyphomycetes. COLONY white, glabrous, margin diffuse; attaining 45 mm diam. in 20 days. Sclerotia scattered at the margin, black, less than 1.5 mm diam. SPORULATION

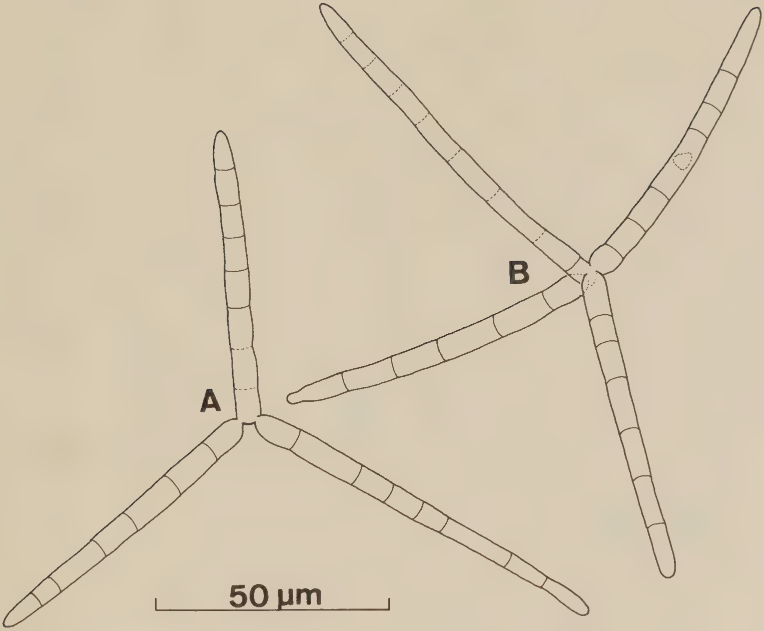

Fig. 12. Lemonniera filiformis (from L11A2). Conidia. Scale bar: 50 μm.

sparse even after several weeks, superficial. CONIDIOPHORES hyaline, solitary or grouped on sclerotia, terminal, cylindrical, septate, distally branched. CONIDIOGENOUS CELLS solitary or grouped, terminal, subulate, phialidic. CONIDIA hyaline, solitary, terminal, elements terete, 4.5-5.5 um wide, multiseptate; axis 66-85 um long, scar inconspicuous; lateral branches (2-)3, verticillate, suprabasal, 65-75 um long. Secession schizolytic.

MATERIAL EXAMINED: L11A2: R. Aiguamòg, ca 1 Km above reservoir, Aran Valley, E. Descals, 11 Nov. 1995.

The conidia of what is believed to be Lemonniera alabamensis Sinclair et Morgan-Jones, also common in the Iberian Peninsula, differ in that they bear a slight constriction on the axis just above the verticil of branches, and all elements are more fusoid.

17- Lemonniera terrestris Tubaki 1958

Hyphomycetes. COLONY very pale beige, glabrous; attaining 28 mm diam. in 12 days or 41 mm in 16 days, depending on the isolate. Sclerotia scattered, black, under 1 mm diam. Hyphae producing scattered, lateral, ellipsoid hyphopodia. SPORULATION sparse after 7 days in water, but abundant after a further 5-11 days, submerged or superficial.

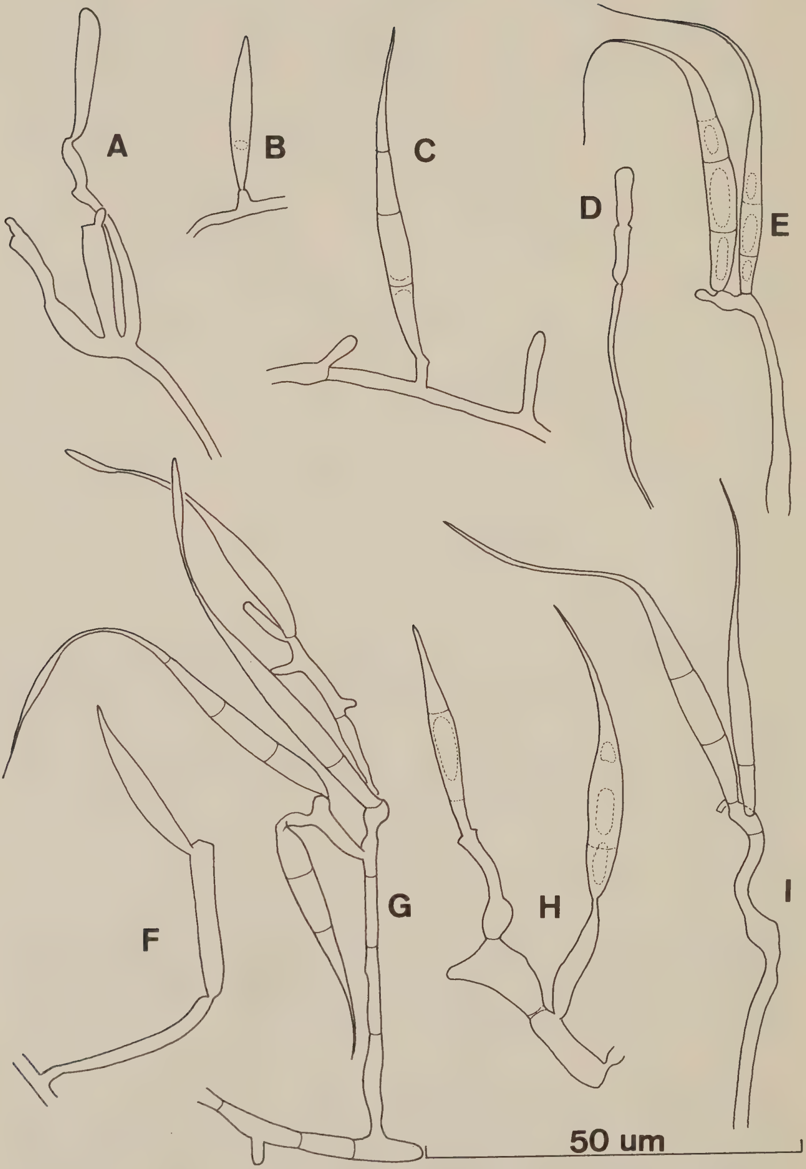
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Fig. 13. Mycocentrospora sp. (from L20A1). A-I. Conidiogenesis. Scale bar: 50 μm.

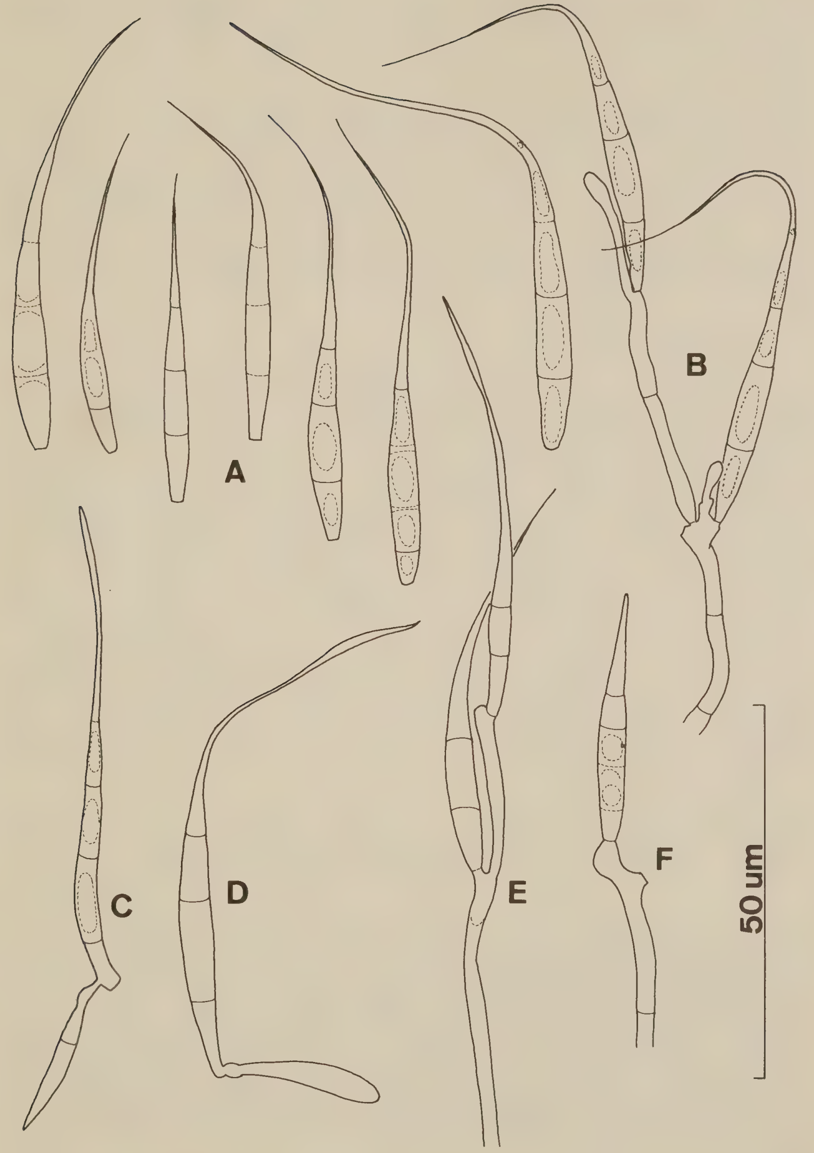

Fig. 14. Mycocentrospora sp. (from L20A1). A. Free conidia. B, E, F. Conidiogenesis. C, D. Development of secondary conidia from near the base of primary ones. Scale bar: 50 μm.

MATERIAL EXAMINED: L5A1: R. Ter, above Setcases, Cerdanya, E. Descals, 8 Nov. 1995; L14A8, L14A10, L14A11, L14A16: Arriu dera Soberpèra, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

18- Mycocentrospora acerina (Hartig) Deighton 1972

Hyphomycetes. COLONY whitish with radial reddish-brown strands, glabrous; attaining 48 mm diam. in 7 days. SPORULATION not seen after 7 days in water, but abundant after a further 7 days, superficial. Conidia are also formed on hyphae newly produced after colony submersion.

MATERIAL EXAMINED: L17A17: stream at Barranc deth Cap deth Pish, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

19- Mycocentrospora sp.

Figs. 14,15

Hyphomycetes. COLONY pale grey, centre darker, glabrous, margin diffuse; attaining 32 mm diam. in 16 days (L20A1). SPORULATION abundant after 6 days in water, superficial or submerged, on hyphae newly formed after colony submersion. CONIDIOPHORES hyaline, solitary, terminal or lateral, micro- to semimacronematous, and then simple or sparsely branched distally, 2-7 um wide, septate. CONIDIOGENOUS CELLS solitary or grouped, terminal or lateral, sometimes intercalary, integrated or discrete and variously shaped, 3-25 um long, polyblastic, scars broad, flat to denticulate; proliferations typically sympodial. CONIDIA hyaline, solitary or grouped, terminal or lateral, 40-85 (incl. filiform appendage) x 3.5-4.5 um; main body long-navicular, straight or more often subcurved, 3-4 septate, septa often obscure, base truncate; filiform appendage cellular, integrated, curved or more typically whip- or lash-like. Secession schizolytic. Secondary conidia of a similar shape may arise from near the base of the primary ones after detachment.

MATERIAL EXAMINED: L11A6: R. Aiguamòg above the reservoir, Aran Valley, E. Descals, 11 Nov. 1995. L20A1: unnamed stream, Artiga de Lin, Aran Valley, E. Descals, 13 Nov. 1995.

Conidia of this type are not commonly seen in streams, and we are probably dealing with a terrestrial species of Mycocentrospora Deighton. This genus is characterized by its conidiophores with broad scars and sympodial elongations, both features being present here. There is some resemblance with conidia of M. veratri (Peck) U. Braun, as suggested by Marvanová (in litt.), although in the latter, the whip-like extension is not as evident, the conidiophore is shorter and single, the conidiogenous cells are more typically percurrent and conidial septa are conspicuous and 3-8 in number.

Conidial shape greatly resembles that of Spermospora Sprague. But here the conidiophores were defined as short, very narrow processes arising from vesicular cells grouped as layers under the host epidermis (Deighton 1968). The

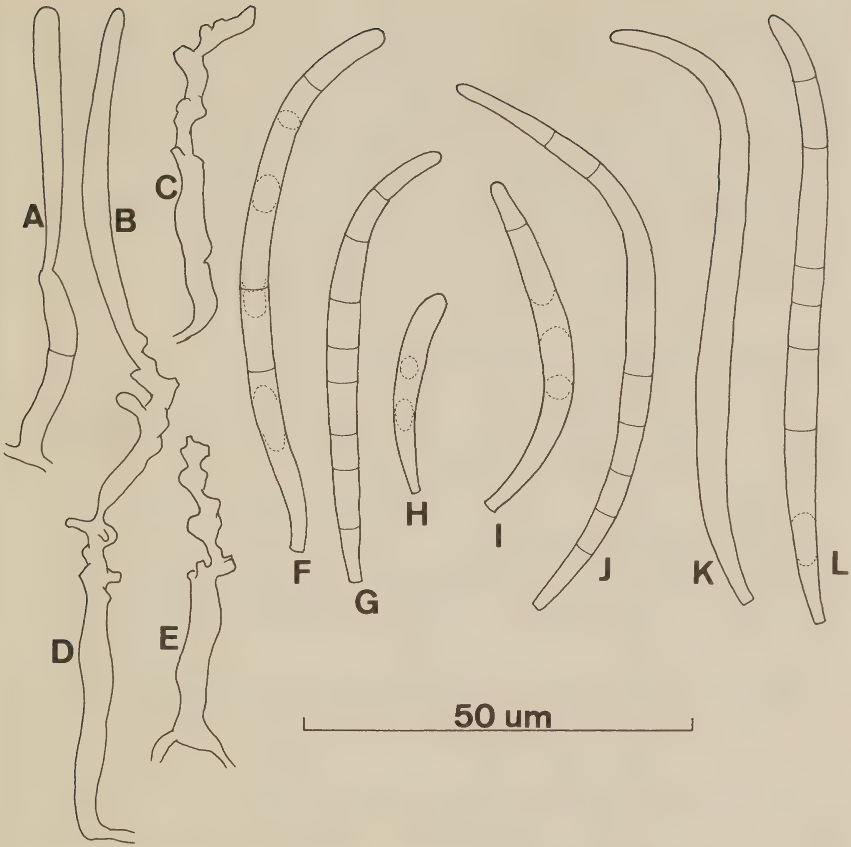

Fig 15. Sigmoidea aurantiaca (from L19A9). A-E. Rachiform conidiophores and conidial development. F-L. Conidia. Scale bar: 50 µm.

conidiophores in L20A1, on the contrary, are typically well developed. Colony characters cannot be contrasted with Deighton's taxa because these were not cultured, but there is mention of pale olivaceous (i.e. dematiaceous) mycelial pigments within the leaf. Three species are described in his account, none of which conidia quite match ours. In S. subulata (Sprague) Sprague they are only 16-65 um long (presumably including the filamentous appendage or "rostrum"), the basal constriction being much more abrupt than in our case. In S. ciliata (Sprague) Deighton and S. avenae (Sprague et Johnson) Sprague, conidia are only up to 48 and 33 um long respectively.

The colony in L11A6 grew much slower than the other, attaining only 9 mm diam. in 27 days.

20- Sigmoidea aurantiaca Descals 1982

Fig. 13

Hyphomycetes. COLONY salmon-orange, centre bright orange, with some concentric rings of denser mycelium, glabrous, margin slightly lobed; attaining 11 mm diam. in 28 days. SPORULATION undetected after 6 days in water but abundant after a further 7 days, superficial. CONIDIOPHORES hyaline, solitary, lateral, semimacronematous, 3.5-4 um wide, unbranched. CONIDIOGENOUS CELLS solitary, terminal, integrated, polyblastic, scars denticulate; proliferations sympodial, variously swollen, eventually rachiform. CONIDIA solitary, terminal, long-fusoid, arcuate towards the apex or sinuous, 25-80 x 3.5-4.5 um, hyaline, multiseptate; scar truncate. Secession schizolytic.

MATERIAL EXAMINED: L19A9: Canaleta de Pomèro, Artiga de Lin, Aran Valley, E. Descals, 13 Nov. 1995.

This is only the second report of S. aurantiaca in culture, the protologue having been based on British material. The orange pigment and rachiform conidiophores are considered highly diagnostic.

21- Stenocladiella neglecta (Marvanová et Descals) Marvanová et Descals 1987

Hyphomycetes. COLONY white with dark grey centre or radial streaks, glabrous or with sparse, low aerial mycelium; attaining 7-10 mm diam. in 1 month, depending on isolate. SPORULATION abundant after 7-9 days in water, submerged.

MATERIAL EXAMINED: L5A2 and L5A21, R. Ter, above Setcases, Cerdanya, E. Descals, 8 Nov. 1995; L6A1, L6A7: left tributary of R. Ter at Setcases, Cerdanya, E. Descals, 8 Nov. 1995.

22- Tetracladium marchalianum De Wild. 1893

Hyphomycetes. COLONY white, glabrous; attaining ca. 38 mm diam. in 16-19 days, depending on the isolate. SPORULATION detected after 6 days in water.

MATERIAL EXAMINED: L7A1: unnamed stream below Campelles, Ripollés, E. Descals, 10 Nov. 1995. L20A8: unnamed left tributary of R. Joeu, Artiga de Lin, Aran Valley, E. Descals, 13 Nov. 1995.

23- Titaeella cf. capnophila Arnaud 1951

Figs. 16,17

Basidiomycete anamorph. COLONY white, with rays of denser immersed mycelium, glabrous, margin diffuse; attaining 19 mm diam. in 19 days. SPORULATION abundant after 6 days in water, submerged. Hyphae branched, septate, 1.5-5.5 um wide, clamped. CONIDIOPHORES hyaline, solitary, micronematous to semimacronematous, and then terminal or lateral, 2-3 um wide, septate, clamped. CONIDIOGENOUS CELLS solitary, apical, integrated, monoblastic, secession clamp present, its remains sometimes visible after secession. CONIDIA hyaline, solitary, terminal, multiseptate, elements somewhat tapering distally, cells subinflated, apex rounded, insertion broad; axis 40-45(-60) x 5-8 um, 2-4 septate, base truncate, sometimes bearing remains of secession clamp; branches typically 2, often aborting or incomplete, arising as extensions of clamp cells, lateral, in 2 orders, 5-8 um wide; primary branch solitary, seldom 2 (fig. 17J), submedian, slightly retrorse, 15-35 um long, 1(-2) septate; secondary branch arising at the base and lower side of the primary branch, strongly retrorse, 5-25 um long, 0-1(-2) septate, insertion often double-clamped (figs. 16 I, 17 J).

MATERIAL EXAMINED: L17A8: stream in Barranc deth Cap deth Pish, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

Arnaud (1951) described T. capnophila on sooty moulds in France. The species was invalidly published. His figure 5I depicts a conidium similar in size and shape to those of L17A8, except that clamps are lacking. However there is a clamped conidial attachment and further clamps on the conidiophore and supporting vegetative hypha. Ando & Tubaki (1985), without seeing the holotype, validated the generic and species names with cultures derived from conidia in rainwater dripping off Pinus densiflora Sieb. et Zucc. in Japan. Their fungus produced clamps on hyphae, conidiophores and conidia, as in our case. The conidial axis was described as not exceeding 41 um in length. However, fig. 15 (a photograph) shows a "mature conidium" which is 62 um long, and those drawn in fig. 3 reach 54 um. Ours are 40-60 um long, and therefore fall within Ando & Tubaki's concept of their species. The remaining features are also comparable. Because we have not examined Arnaud's specimen, our identification will have to remain tentative. This fungus is probably seldom dispersed in streams, and the conidium we isolated may have been washed in from an allochthonous, epiphytic habitat.

24- Tricellula aquatica Webster 1959

Fig. 18

Hyphomycetes. COLONY salmon-orange. SPORULATION aerial, on the unsubmerged colony. CONIDIOPHORES hyaline, forming gloeoid pustules, lateral, semimacronematous, densely branched, multiseptate, elements 2-4 um wide. CONIDIOGENOUS CELLS aggregated, terminal (or lateral or intercalary), discrete, 4-9 x 2-3 um, polyblastic. CONIDIA hyaline, solitary or more commonly grouped, terminal (or lateral), typically Y-shaped, i.e. composed of 1 primary body and 2 branches, one of them more or less apical, the other subapical. Primary body obovoid to clavate, straight or subcurved, 4-8 x 1.5-2.5 um; branches long-navicular to fusoid, often slightly sinuous, 3-9 x 1.5-2 um. Secession schizolytic.

MATERIAL EXAMINED: L5A19: R. Ter, above Setcases, Cerdanya, E. Descals, 8 Nov. 1995.

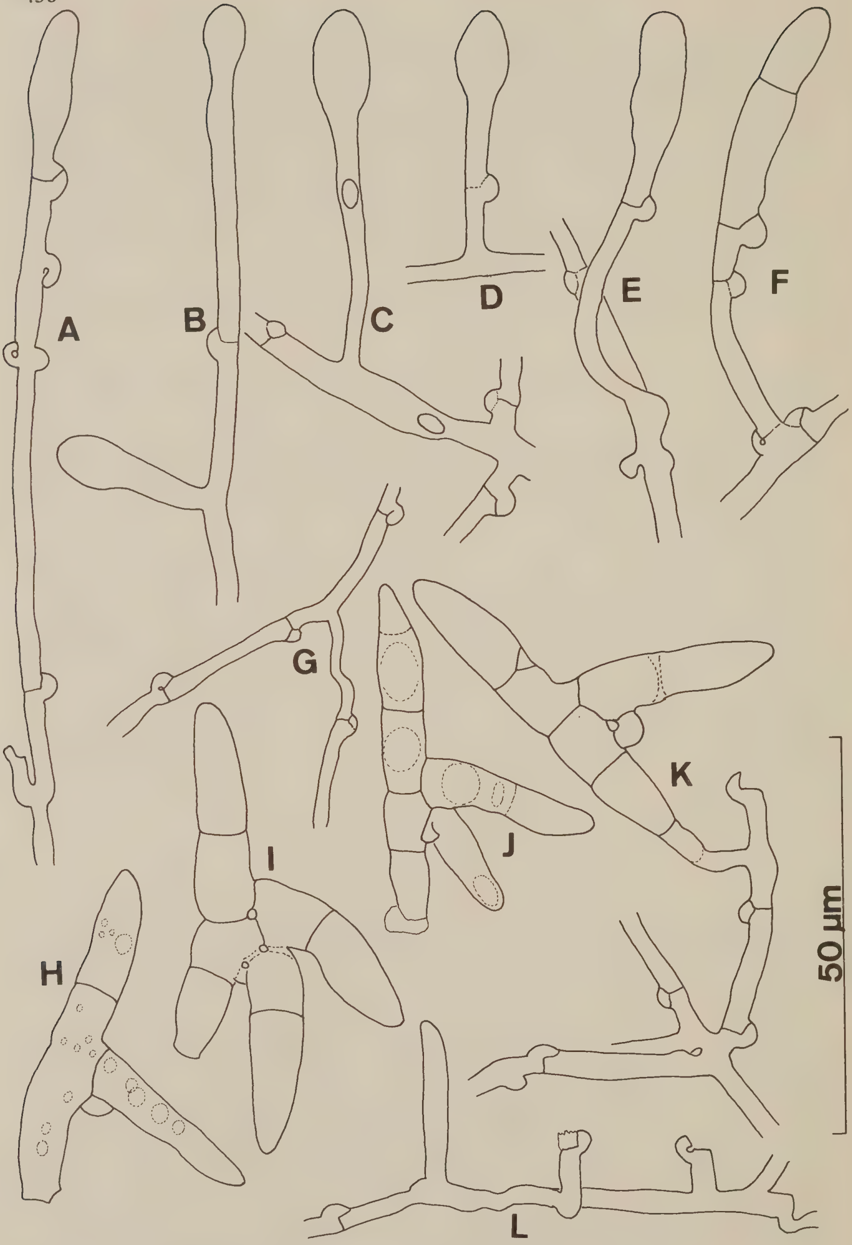
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Fig. 16. Titaeella cf. capnophila (from L17A8). A–G, K, L. Conidiophores. H–J. Conidia. Scale bar: 50 µm.

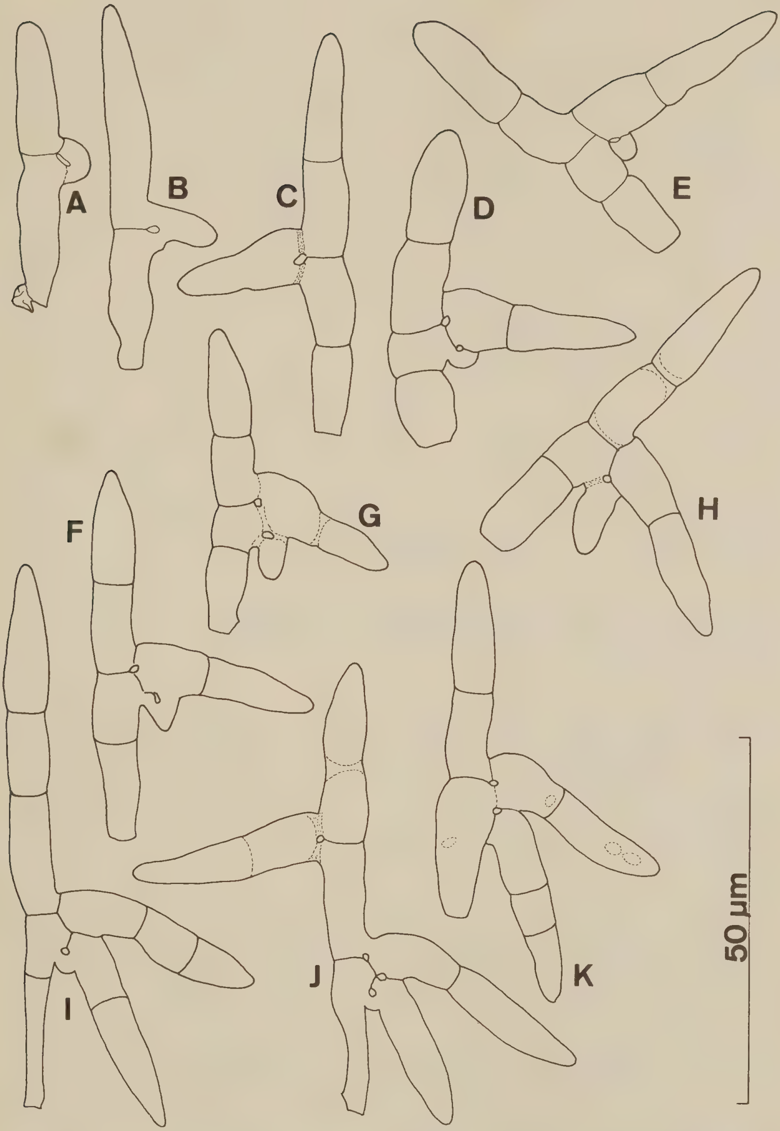


Fig. 17. Titaeella cf. capnophila (from L17A8). Free conidia, in a sequence which reconstructs branch development: B. Initiation of primary branch. D. Basal clamp formation on primary branch. F. Initiation of secondary branch. A. Note remains of secession clamp. Scale bar: 50 μm.

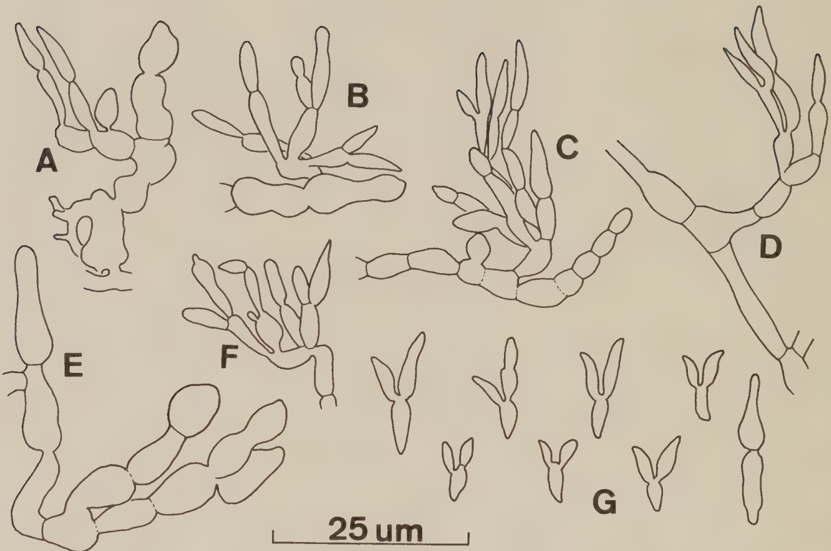


Fig. 18. Tricellula aquatica (from L5A19). A-D, F. Conidiophores. E. Swollen cells. G. Conidia. Scale bar: 25 μm.

25- Tricellula sp.

Fig. 19

Hyphomycetes. COLONY pale orange in the central 20 mm diam., glabrous, margin white; attaining 21 mm diam. in 16 days. SPORULATION abundant after 6 days in contact with water. CONIDIOPHORES not seen. CONIDIA hyaline, 11-14 um in span, branched more or less symmetrically in one plane, typically composed of a basal primary element bearing 1 apical and 2 lateral, wing-like elements. Basal element ellipsoid, 4-5 x 2-3 um; apical element cuneiform to sagittate, i.e.: with 2 pointed suprabasal opposite extensions and an acute apex, 4-8 x 3.5-4.5 um; lateral elements opposite, supramedian, sometimes an extra element near the base, guttuliform, somewhat retrorse, sinuate, often with a lateral pointed projection on the lower side. Germination apical on the secondary elements.

MATERIAL EXAMINED: L20A2: unnamed left tributary of R. Joeu, Artiga de Lin, Aran Valley, E. Descals, 13 Nov. 1995.

Conidia of this shape, very similar to those of Volucrispora ornithomorpha (Trotter) Haskins, except for the pointed lateral projections, were previously seen in foam from the Pyrenees by Descals (1987), but not, however, in the recent collections by Descals & Moya (in press) from the same site as the present isolate. Although this is undoubtedly an undescribed species, it cannot be formally named because conidiophores have not been found. It is,

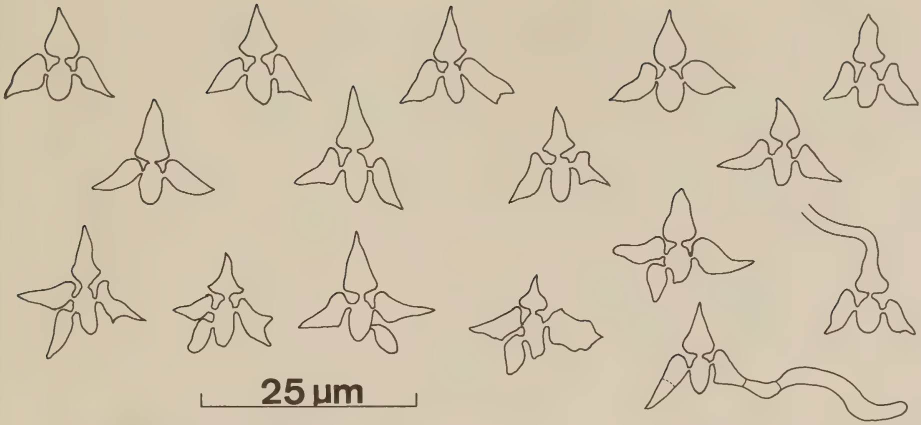


Fig. 19. Tricellula **sp. (from L20 A2). Conidia. Scale bar: 25 µm.**

nevertheless, believed to belong to Tricellula v. Bev. because of the orange pigment, which is typical of the genus. The same fungus has been recently reported from stream foam in the Argentinian Andes by Siracusa (pers. comm.)

26- Tricladium angulatum Ingold 1942

Hyphomycetes. COLONY pale beige, glabrous; attaining 27 mm diam. in 16 days. SPORULATION abundant after 6 days in water, submerged.

MATERIAL EXAMINED: L7A2: unnamed stream below Campelles, Ripollés, E. Descals, 10 Nov. 1995.

This fungus had not been recorded from Pyrenean foam by Descals & Moya (in press). It is common in alkaline waters, but not so much in mildly acid ones such as those sampled here.

27- Tricladium sp.

Fig. 20

Hyphomycetes. COLONY white with some concentric rings of denser mycelium, glabrous, margin diffuse; attaining 19 mm diam in 21 days or 26 mm in 1 month, depending on the isolate. SPORULATION undetected after 6 days in water, but very sparse within a further 9 days, superficial or underwater. CONIDIOPHORES not seen. CONIDIA hyaline, 55-75 um in span, elements 5, 2-4 um wide, cells sometimes subinflated; basal element subcylindrical to long-clavate, 20-27 um long, scar broad, 1-2 septate; parabasal extension not seen; 2 elements arising apically on the first: one element subulate, 30-35 um long, 1-2 septate, the other short-cylindrical, ca. 14 um long, 0-septate; 2 further elements arising apically on the latter, subulate, 16-35 um long, 0-2 septate, apex rounded. Germination apical and suprabasal.

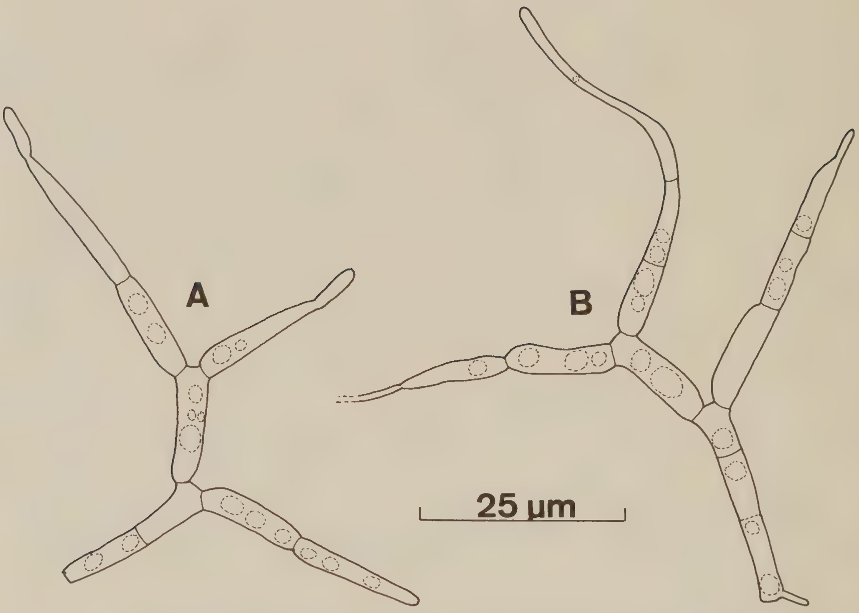


Fig. 20. Tricladium sp. (from L10A1). A-B. Conidia. B. Germ tube or parabasal extension. Scale bar: 25 μm.

MATERIAL EXAMINED: L10A1: R. Aiguamòg, above the reservoir, Aran Valley, E. Descals, 11 Nov. 1995; L3A5: R. Ter, Vallter, Cerdanya, E. Descals, 8 Nov. 1995; L17A1, L17A9: stream in Barranc deth Cap deth Pish, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

The conidia here are quite similar to those of Tricladium caudatum Kuzuha (1973), except that, as remarked by L. Marvanová (in litt.) the parabasal appendage is lacking. The same conidia have been reported in stream foams (Descals 1987, Regelsberger et al. 1987, Messner & Stüwe 1986) and on submerged leaf baits (Wood-Eggenschwiler & Bärlocher 1983) elsewhere in Europe. Hence our interest in isolating this fungus, but here again conidiophores could not be found because sporulation was too sparse. Identification must thus remain tentative. In the present case, the very characteristic conidia with what could be interpreted as sympodial branching match those illustrated by Kuzuha (1973), except that the parabasal extension is missing. It is curiously enough present on the two conidia drawn by Descals & Moya (in press) from L4 and L15, both sites being very near L3 and L17, where the fungus was sampled for isolation. They could be confused at first sight with those of Tricladium curvisporum (see below), but these bear a recognizable, uninterrupted axis, from which two branches arise laterally.

28- Tricladium curvisporum Descals 1983

Hyphomycetes. COLONY white, glabrous, immersed mycelium forming denser radial streaks; attaining 35 mm diam. in 19 days (L3A2). SPORULATION abundant after 6 days in water, submerged. CONIDIOPHORES not seen. CONIDIA hyaline, elements subulate, septate, apices rounded; axis strongly curved in the lower half, 40-75 x 2.5-3.5 um, base rounded, often mucronate; branches lateral, solitary, appearing progressively, diverging broadly, insertion subconstricted, 10-42 x 2-4 um. Germination polar.
MICROCONIDIAL STATE not seen.

MATERIAL EXAMINED: L3A2: R. Ter, Vallter, Cerdanya, E. Descals, 8 Nov. 1995; L4A8: small left tributary of R. Ter, (same locality and date); L10A4: R. Aiguamòg above the reservoir, Aran Valley, E. Descals, 11 Nov. 1995.

(See under Tricladium cf. caudatum).

29- Tridentaria sp.

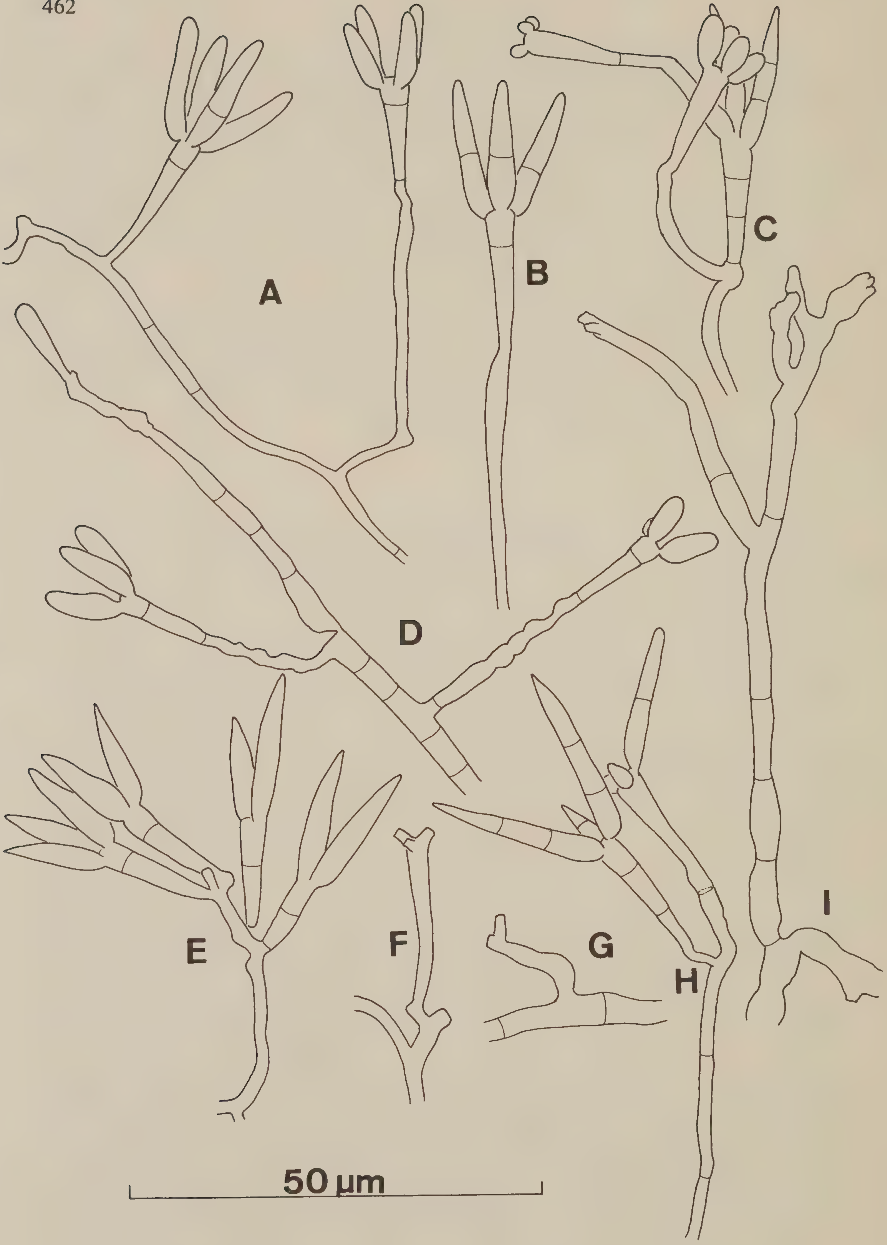
Figs. 21,22

Hyphomycetes. COLONY orange, fading with age to pale salmon-coloured, with some concentric rings of denser mycelium, glabrous, margins lobed; attaining 8 mm diam. in 23 days, or 14 mm in 1 month depending on the isolate. SPORULATION abundant after 6 days in water, submerged. CONIDIOPHORES hyaline, solitary, terminal or lateral, micronematous to semimacronematous, and then simple or sparsely branched, 1.5-3 um wide. CONIDIOGENOUS CELLS solitary or grouped, terminal, integrated or discrete, and then 3-12 x 1-3 um, polyblastic, scars denticulate; proliferations sympodial. CONIDIA hyaline, solitary, typically terminal; axis subclavate, 12-18 x 2-4 um, mostly 2 septate, scar flat or with a mammillate or short-conoid projection; branches (2-)3(-4), coronate, synchronous, long-navicular, 13-26 um long, 1-4 septate, apex subacute, insertion constricted. Secession schizolytic. Germination apical.

MATERIAL EXAMINED: L17A11: stream at Barranc deth Cap deth Pish, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995; L19A6: Canaleta de Pomèro, Artiga de Lin, Aran Valley, E. Descals, 13 Nov. 1995; L20A8: small, unnamed left tributary of R. Joeu, Artiga de Lin, Aran Valley, E. Descals, 13 Nov. 1995.

In L17A11, sporulation was profuse within the agar. Conidia undoubtedly belonging to the same taxon were collected previously from the same streams by Descals & Moya (in press).

Isthmotricladia britannica Descals, with conidia structurally similar to the present ones, has also been isolated from Spain by Roldán (1991), although only from alkaline streams in the S.E. Moreover, the conidia are larger (axis 14-32 um long, branches 25-50 um long) and the branches are distinctly more delicate. We are most probably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50 µm

Fig. 21. Tridentaria sp. (A-D, H from L19A6; E-G, I from L20A8). Condiophores and conidial development. Scale bar: 50 μm.

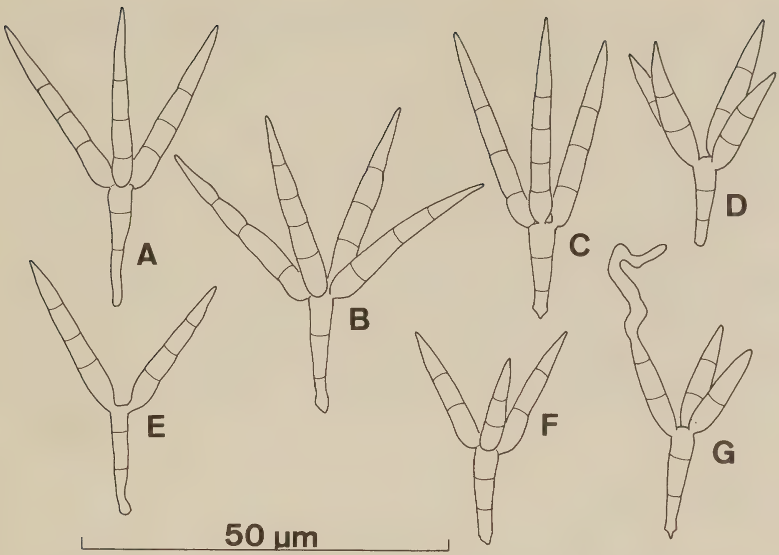

Fig. 22. Tridentaria sp. (A-F from L19A6; G from L20A8) Conidia. Scale bar: 50 μm.

dealing with a species of Tridentaria Preuss, but this genus is in need of revision, and a species name cannot yet be safely coined here. Matsushima (1989) has described T. subuliphora, but here the colony (on V8A) is brown and, as regards the conidia, branches are 22-35 um long, the apices are rounded and cells are more regularly swollen. The fungus is only known from Australia.

30- Triscelophorus cf. acuminatus Nawawi 1975

Hyphomycetes. COLONY white with inoculum area grey, glabrous, margin diffuse; attaining 16 mm diam. in 1 month. SPORULATION abundant after 6 days in contact with water, submerged. CONIDIOPHORES hyaline, solitary, terminal, semimacronematous, unbranched, 1-1.5 um wide. CONIDIOGENOUS CELLS solitary, terminal, integrated, monoblastic. CONIDIA hyaline, solitary, terminal; elements long-navicular, septa obscure, apices subacute to acute; axis ca. 40 x 3.5 um, base truncate; branches typically 3, verticillate, suprabasal, sequential, ca. 25 x 2.5 um long. Secession schizolytic.

MATERIAL EXAMINED: L1A12: stream below Castell de Requesens, Empordà, E. Descals, 7 Nov. 1995.

T. monosporus Ingold differs basically in the presence of a swollen basal cell on the conidial axis, while in T. acuminatus the axis tapers smoothly throughout its length.

But this character is often unclear, and identification must remain tentative for our isolate. The same conidial form was reported by Descals & Moya (in press) from the same foam.

31- Tumularia tuberculata (Gönczöl) Descals et Marvanová 1987

Hyphomycetes. COLONY whitish with fine radial strands of denser mycelium, glabrous, margin white; attaining 23 mm diam. in 19 days (L1A1). SPORULATION sparse after 6 days in water, but abundant after a further 9 days, submerged. CONIDIOPHORES hyaline, solitary, terminal, semimacronematous, unbranched, up to 3 um wide. CONIDIOGENOUS CELLS solitary, terminal, integrated, monoblastic, scars broadened to 6 um wide; proliferations several times percurrent, annellate. CONIDIA hyaline, solitary, terminal; main body clavate, ca. 25 x 15 um, apex rounded, base more or less truncate, 1-septate; processes (0-)4, on the apical cell, conoid, 6-8 x 6-8 um. Secession schizolytic.

MATERIAL EXAMINED: L1A1 and L1A3: stream below Castell de Requesens, Empordà, E.Descals, 7 Nov. 1995.

32- Varicosporium delicatum Iqbal 1971

Hyphomycetes. COLONY white with scattered, creamy beige mycelial knots under 1 mm diam., glabrous; attaining 30 mm diam. in 16 days. SPORULATION undetected after 6 days in water but abundant after a further 9 days under NUV, superficial and submerged. CONIDIOPHORES hyaline, as scattered clumps, micro- to semimacronematous and then lateral, up to 25 x 1-2.5 um, simple or sparsely branched apically. CONIDIOGENOUS CELLS solitary (or paired), terminal, integrated, mono- or polyblastic, scars flat to denticulate; proliferations sparse, sympodial. CONIDIA hyaline, terminal, solitary or paired, loosely arborescent, up to 120 um in span, branched in 1 or more orders; elements long-cylindrical, often with smooth intercalary attenuations, gently to strongly arcuate, 1-1.5 um wide, sparsely or obscurely septate, apices rounded; axis with truncate base, branches lateral, single, insertion often subconstricted; primary branches 1-3, secondary branches 0-2. Detached conidia fragmenting readily into branched or unbranched part-conidia down to 10 um long.

MATERIAL EXAMINED: L11A3: R. Aiguamòg, Aran Valley, E. Descals, 11 Nov. 1995.

Conidial span here is in the lower end of the range for V. delicatum, but the rest of the characters, except for the apparent lack of conidial septa, which may be due to poor staining, match those of the species. The fungus was not seen in parallel foam surveys carried out by Descals & Moya (in press).

33- Varicosporium elodeae Kegel 1906

Hyphomycetes. COLONY white with scattered radii of denser mycelium, or creamy white with scattered beige hyphal aggregations, glabrous; attaining 26 mm diam. in 12 days or 47 mm in 16 days depending on the isolate. SPORULATION abundant after 7 days in water, superficial or submerged.

MATERIAL EXAMINED: L4A1: small, unnamed left tributary of R. Ter, Vallter, Cerdanya, E. Descals, 8 Nov. 1995. L17A16: stream at Barranc deth Cap deth Pish, nr. Les, Aran Valley, E. Descals, 12 Nov. 1995.

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References

-Ando, K., & Tubaki, K. 1985. Three new hyphomycetes from Japan: Anthopsis microspora, Scutisporus brunneus and Titaeella capnophila. Trans. mycol. Soc. Japan 26: 151-160.
-Arnaud, G. (1951). Les boucles myceliénnes des Eumycètes et la phylogenie des Uredinées. Bull. Soc. mycol. France 67: 196-198.
-Deighton, F.C. 1968. Spermospora. Trans. Br. mycol. Soc. 51: 41-49.
-Descals, E. (1987). Muestreo preliminar de hongos ingoldianos de Cataluña. Rev. Ibér. Micol. 4: 17-32.
-Descals, E., & Díaz, A. (in prep). Techniques for the study of Ingoldian fungi. Cuadernos de Trabajo, Flora Micológica Ibérica.
-Descals, E., & Moya, O. (in press). Fungal spora from streams in the Catalan Pyrenees. Bol. Soc. Micol. Madrid.
-Descals, E., Marvanová, L., & Webster, J. (in prep.) New taxa and new combinations of "Aquatic Hyphomycetes" II.
-Kuzuha, S. (1973). Two new species of aquatic hyphomycetes. J. Jap. Bot. 48: 220-224.
-Marvanová, L. & Descals, E. (1985). New and critical taxa of aquatic hyphomycetes. Bot. J. Linn. Soc. 91: 1-23.
-Marvanová, L., Descals, E., & Webster, J. (in press). New taxa and new combinations of hyphomycetes from streams. Mycotaxon.
-Matsushima, T. (1989). Matsushima Mycological memoirs No. 6. Matsushima Fungus Collection, Kobe, 100 pp.
-Messner, K., & Stüwe, B. (1986). Aquatische Hyphomyzeten: aussergewöhnlicher Formenreichtum in der Ysperklam. Wasser u. Abwasser 30: 215-223.

-Regelsberger, B., Messner, K., & Descals, E. (1987). Species diversity in Aquatic Hyphomycetes in four Austrian streams. Mycotaxon 30: 439-454.

-Roldán, A., Descals, E., & Honrubia, M. (1987). Dendrospora polymorpha sp. nov., a hyphomycete from Spanish streams. Mycotaxon 29: 21-27.

-Webster, J., & Descals, E. (1981). Morphology, distribution and ecology of conidial fungi in freshwater habitats. In: Cole, G.T., & Kendrick, B. (Eds.). The biology of conidial fungi. Acad. Press, N.Y., vol. I, pp. 295-355.

-Wood-Eggenschwiler, S., & Bärlocher, F. (1983). Aquatic hyphomycetes in sixteen streams in France, Germany and Switzerland. Trans. Br. mycol. Soc. 81: 371-379.

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ANNOTATED LIST OF THE LOPHIOSTOMATACEAE AND MYTILINIDIACEAE (DOTHIDEALES, ASCOMYCOTINA) REPORTED FROM THE IBERIAN PENINSULA AND BALEARIC ISLANDS

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ABSTRACT

A second checklist of the dothideaceous fungi (Lophiostomataceae and Mytilinidiaceae) of the Iberian Peninsula and Balearic Islands, based on bibliographic data, is given. Nomenclatural problems are commented upon under the "Observations."
The genus *Sampaioa* considered in *Lophiostomataceae* by some authors (ERIKSSON & HAWKSWORTH, 1993; HAWKSWORTH & al., 1995) is excluded. A new combination, *Nodulosphaeria asteris-alpini* (Gonz. Frag.) Checa, is proposed.

MATERIALS AND METHODS

As in the previous paper the catalogue has been compiled of all the generic, specific and infraspecific taxa of *Lophiostomataceae* and *Mytilinidiaceae* recorded in the Iberian Peninsula (Portugal and Spain) and Balearic Islands based on bibliographic data.

Material of those species included in this catalogue which was available from different herbaria has been revised.

The methodology followed in the project was discussed by TELLERIA (1990) and it is explained in the paper about the family Hysteriaceae (CHECA, 1997). Like in that paper, every taxon is accompanied with information about its chorology (see the map with the symbols of each province, fig. 1; a number between parentheses indicates the bibliographic reference where the taxon is cited), substrate and the herbaria where the material is deposited. In "Observations" I have attempt to clarify the difficulty in the nomenclature.

At the end of each family, there is a list with the doubtful and excluded taxa. I have followed for the nomenclature, the sensu of BARR (1992), HAWKSWORTH & al. (1995), HOLM,L. & HOLM,K. (1988) and ZOGG (1962).

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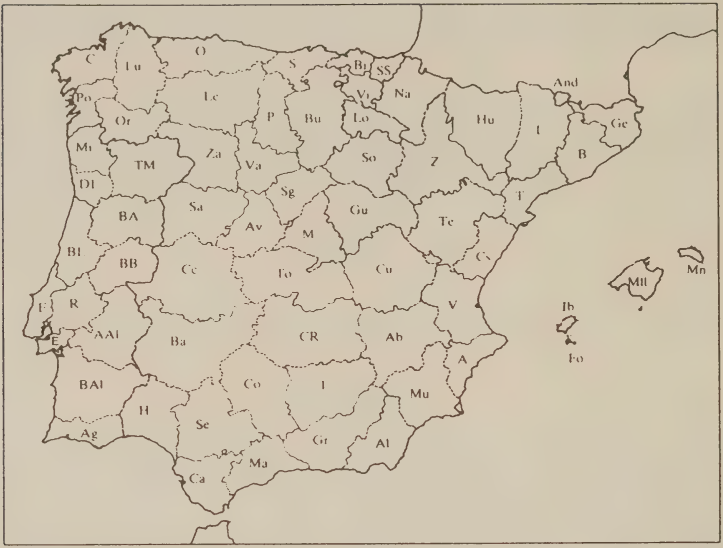
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Ba Badajoz
Bi Vizcaya
Bu Burgos
C La Coruña
Ca Cádiz
Cc Cáceres
Co Córdoba
Cs Castellón
CR Ciudad Real
Cu Cuenca
Ge Gerona
Gr Granada
Gu Guadalajara
H Huelva
Hu Huesca
J Jaén
L Lérida
Le León
Lo La Rioja
Lu Lugo
M Madrid
Ma Málaga
Mu Murcia
Na Navarra
O Asturias
Or Orense
P Palencia
Po Pontevedra
S Cantabria
Sa Salamanca
Se Sevilla
Sg Segovia
So Soria
T Tarragona
Te Teruel
To Toledo
V Valencia
Va Valladolid
Z Zaragoza
Za Zamora

BALEARES
Fo Formentera
Ib Ibiza
Mll Mallorca
Mn Menorca

PORTUGAL (PRT)
AAl Alto Alentejo
BA Beira Alta
BAl Bajo Alentejo
BB Beira Baixa
BL Beira Litoral
DL Douro Litoral
E Estremadura
Mi Minho
R Ribatejo
TM Trás-os-Montes

Fig. 1. – Symbols of each province

Herbaria

The herbaria where the material is deposited, is indicated. As most of them maybe unfamiliar I include a list with their corresponding addreses below.

AH.- Departamento de Biología Vegetal. Facultad de Ciencias. Universidad de Alcalá de Henares, 28871 Madrid. Spain.
BCC-DSL or **DSL.**- Private herbarium of D. Sierra. Departamento de Biología Vegetal, Facultad de Biología, Universidad de Barcelona. 08071 Barcelona. Spain.
COI.- Jardim Botânico. Departamento de Botânica (Instituto Botânico Dr. Júlio Henriques). Universidade de Coimbra. Coimbra (Portugal).
GD.- Private herbarium of G.Díaz. Departamento de Biología Vegetal, Facultad de Biología. Universidad de Murcia. 30071 Murcia. Spain.
HJCh.-GM.- Private herbarium of J. Checa & G.Moreno deposited in AH.
I. Melo.- Private herbarium of I. Melo. Museo e Jardim Botânico. Universidade de Lisboa. Rua da Escola Politécnica 58. 1200 Lisboa. Portugal.
JL.- Private herbarium of J. Larios. Departamento de Biología Vegetal, Facultad de Biología. Universidad de Murcia. 30071Murcia. Spain.
LISE.- Fitosistemática e Geobotânica, Estaçao Agronómica Nacional. P-2780. Oeiras. Portugal
LISFA.- Conservaçao dos Recursos Naturais, Estaçao Florestal Nacional de Investigaçao Agrária, P-130. Lisboa. Portugal
MA-Fungi.- Real Jardín Botánico, C.S.I.C., Plaza de Murillo 2. 28014 Madrid. Spain.
MHG.- Private herbarium of M. Honrubia. Departamento de Biología Vegetal, Facultad de Biología. Universidad de Murcia. 30071 Murcia. Spain.
MUB.- Departamento de Biología Vegetal, Facultad de Biología. Universidad de Murcia. 30071 Murcia. Spain.
PACA.-Herbarium Anchieta-Paca. Instituto Anchietano de Pesquisas. Praça Tiradentes, 35. Cx.P. 275. 93010-020 Sao Leopoldo-RS (Brasil).

BIBLIOGRAPHY SURVEYED FOR THE COMPILATION OF THE CATALOGUE

1).- ALMEIDA, J. VERÍSSIMO & CÂMARA, M.SOUSA (1909). Contributiones ad mycofloram lusitaniae. Centuriae III. IV, V. Bol. Soc. Brot. 24:150-213.
2).- BAUSÁ, M. (1945). Datos micológicos. Anales Jard. Bot. Madrid 5:143-160.
3).- BERTAULT, R. (1974). Contribution à la flore mycologique de l'Andalousie. II. Collect. Bot. (Barcelona) 9(2):25-44.
4).- CÂMARA, M. SOUSA (1910). Contributiones ad mycolfloram Lusitaniae. Centuria VI. Bol. Soc. Brot. 25:5-25.
5).- CÂMARA, M. SOUSA (1946).Contributionesd mycofloram Lusitaniae. Centuria XII. Agron. Lusit. 8(1):19-71.
6).- CÂMARA, M. SOUSA (1947). Mycetes aliquot Lusitaniae VII. Agron. Lusit. 9(2):85-128.

7).- CÂMARA, M. SOUSA (1949). Mycetes aliquot Lusitaniae X. Agron. Lusit. 11(3): 165-189.

8).- CÂMARA, M. SOUSA (1951). Mycetes aliquot Lusitaniae XI. Agron. usit. 13(2):117-151.

9).- CÂMARA,M. SOUSA & LUZ, C.G. (1939). Mycetes aliquot Lusitaniae II. Agron. Lusit. 1(1):41-63.

10).- CÂMARA, M. SOUSA & LUZ, C.G. (1939). Mycetes aliquot Lusitaniae III.Agron.Lusit. 1(2):167-199.

11).- CÂMARA, M. SOUSA & LUZ, C.G. (1941). Mycetes aliquot Lusitaniae. IV. Agron. Lusit. 3(1):25-47.

12).- CÂMARA, M. SOUSA & LUZ, C.G. (1941). Mycetes aliquot Lusitaniae. Agron. Lusit. 3(4):307-323..

13).- CÂMARA, M. SOUSA & LUZ, C.G. (1943). Mycetes aliquot Lusitaniae. VI. Agron. Lusit. 5(2):119-145.

14).- CÂMARA, M. SOUSA & LUZ, C.G. (1944). Mycetes aliquot Lusitaniae.IV. Bol. Soc. Portug. Ci. Nat. 13(Supl. II):126-140.

15).- CÂMARA,M. SOUSA & VASCONCELOS,A.T. (1955). Fungi Lusitaniae. X. Agron.Lusit. 17(2/4):91-100.

16).- CHECA, J., (1986). Estudio de la clase Pyrenomycetes s. lato (Ascomycotina) en España (Guadalajara, Madrid y Segovia). Univ. Alcalá de Henares (Madrid, Spain). (Tesis doctoral inédita).

17).- CHECA, J., (1990). Estudios sobre Pyrenomycetes y Loculoascomycetes (Ascomycotina),V. Dothideales y Lecanidiales. Bol. Soc. Micol. Madrid 14:99-106.

18).- CHECA, J. (1994). Pyrenomycetes s.lato de reservas naturales ibéricas. Bol. Soc. Micol. Madrid 9:3-14.

19).- CHECA, J. (1995). Pyrenomycetes s. lato de reservas naturales ibéricas. II. Bol. Soc. Micol. Madrid 20:91-97.

20).- CHECA, J. (1996). Pyrenomycetes s. lato de reservas naturales ibéricas. II. Portug. Acta Biol., Sér.B. (in print).

21).- CHECA, J. & MORENO, G. (1984). Estudios sobre Pyrenomycetes y Loculoascomycetes (Ascomycotina).I. Bol. Soc. Micol. Castellana 8:15-22.

22).- CHECA, J. & MORENO, G. (1985). Estudios sobre Pyrenomycetes y Loculoascomycetes (Ascomycotina).II. Bol. Soc. Micol. Castellana 9:5-14.

23).- CHECA, J., BLANCO, M.N. & BARRASA, J.M. (1994). Estudio sobre Pyrenomycetes sensu lato de Menorca. Cryptogamie, Mycol. 15(2):125-132.

24).- COSTA,M.E. & CÂMARA,M. SOUSA, Fungi Lusitaniae.X In:Anónimo (Ed.), Lusitaniae Mycologica et Phytopathologica:94.1955

25).- DIAS, M.R. SOUSA (1956). Fungi Lusitaniae. XV. Agron. Lusit. 18(4):237-242.

26).- DIAS, M.R. SOUSA & LUCAS, M.T. (1965). Fungi Lusitaniae. XX. Agron. Lusit. 26(1):5-19.

27).- DIAS, M.R. SOUSA & LUCAS, M.T. (1967). Fungi Lusitaniae. XXI. Agron. Lusit. 27(2):87-95.

28).- DIAS, M.R. SOUSA & LUCAS, M.T. (1968). Fungi Lusitaniae. XXII. Agron. Lusit. 28(3/4):125-131.

29).- DIAS, M.R. SOUSA & LUCAS, M.T. (1972). Fungi Lusitaniae. Agron. Lusit. 33(1/4): 173-184.

30).- DIAS, M.R. SOUSA & LUCAS, M.T. (1974). Fungi Lusitaniae. XXIV. Agron. Lusit. 35(2):137-144.

31).- DIAS, M.R. SOUSA & LUCAS, M.T. (1975). Fungi Lusitaniae. XXV. Agron. Lusit. 37(1):95-103.

32).- DIAS, M.R. SOUSA, LUCAS, M.T., SAMPAIO, M.H. & SANTOS (1971). Fungi. In: Catálogo das plantas herborizadas. III Reuniao de Botânica Peninsular. Mem. Soc. Brot., Sér. 2, 21: 65-89.

33).- DÍAZ, G., HONRUBIA, M. & TORRES, P. (1987). Notas sobre hongos foliícolas del S.E. español. REv. Ibér. Mycol. 4:93-104.

34).- FERNÁNDEZ RIOFRÍO, B. (1929). Nuevas aportaciones a la micología española. Mem. Real Soc. Esp. Hist. Nat. 15(1):383-388.

35).- GARCÍA BONA, L.M. (1987). Catálogo micológico de Navarra. Cuad. Secc. Ci. Nat. 3:9-287.

36).- GONZÁLEZ FRAGOSO, R. (1914). Contribución a la flora miológica de Guadarrama. Pireniales. Histeriales. Discales. Trab. Mus. Nac. Ci.Nat., Ser. Bot. 4:1-43.

37).- GONZÁLEZ FRAGOSO, R. (1916). Bosquejo de una Flórula Hispalense de Micromicetos. Trab. Mus. Nac. Ci. Nat., Ser. Bot. 10:1-221.

38).- GONZÁLEZ FRAGOSO, R. (1917). Hongos de la provincia de Málaga (Recolectados por D. Cándido Bolivar y D. Enrique Rioja). Bol. Soc. Esp. Hist. Nat. 17:299-311.

39).- GONZÁLEZ FRAGOSO, R. (1919.). Anotaciones micológicas. Hongos de Cataluña. Mem. Real Soc. Esp. Hist. Nat. 11:77-103.

40).- GONZÁLEZ FRAGOSO, R. (1920). Quelques mots sur une nouvelle Lophiostomacée. Bull. Soc. Mycol. France 36(2):103-106.

41).- GONZÁLEZ FRAGOSO, R. (1923). Contribución a la flora micológica lusitánica. Bol. Soc. Brot., Sér. 2, 2:3-83.

42).- GONZÁLEZ FRAGOSO, R. (1924). Hongos del Herbario del Museo de Ciencias Naturales de Barcelona (Serie 7). Butl. Inst. Catalana Hist. Nat. 24:123-130.

43).- GONZÁLEZ FRAGOSO, R. (1925). Adiciones a la micoflora lusitánica. Asoc. Esp. Progr. Ci. Congr. Coimbra (Ci. Nat.) 6:5-27.

44).- GONZÁLEZ FRAGOSO, R. (1926). Hongos de España. (2. Serie). Brotéria, Sér. Bot. 22(2):49-70.

45).- GONZÁLEZ FRAGOSO, R. (1927). Tres notas micológicas: I. Algunos hongos de los Pirineos españoles recolectados por la Srta. Paunero. II. Hongos pirenaicos, y otros, del herbario del Museo de Ciencias Naturales de Barcelona. III. Algunos hongos. Bol. Soc. Esp. Hist. Nat. 27:346-358.

46).- HONRUBIA, M., BERTAULT, R. & LLIMONA,X. (1982). Aportación al conocimiento de los hongos del S.E. de España XIII. Plectomicetes. Loculoascomicetes. Pirenomicetes. Int. J. Mycol. Lichenol. 1(1):1-26.

47).- HONRUBIA, M., ALCARAZ, F., GRACIA, E. & LLIMONA, X. (1982). El componente fúngico de las principales comunidades vegetales del SE de España. Lazaroa 4:313-325.

48).- HONRUBIA, M., LARIOS, J.M. & GALLEGO, E. (1985). Notas sobre Ascomycotina en el S.E. de España eninsular. Anales Jard. Bot. Madrid 42(1):39-48.

49).- LARIOS, J.M. & HONRUBIA, M. (1988). Hysteriaceae Chev. y Lophiaceae Zogg ex Arx & Müller (Ascomycotina) en el Sudeste de la Península Ibérica. Revista Ibér. Micol. 5(3):111-117.

50).- LARIOS, J.M., HONRUBIA, M. & GALLEGO, E. (1988). Notas sobre Ascomycotina en el S.E. de España peninsular. V. Pirenomicetos y Loculoascomicetos saprófitos. Int. J. Micol. Lichenol. 3(2-3):303-317.

51).- LARIOS, J.M., HONRUBIA, M. & MORENO, G.(1986). Estudio de los hongos que fructifican en la vegetación relicta de Abies pinsapo Boiss., en España peninsular. I. Ascomycotina. Acta Bot. Malacitana 11:39-53.

52).- LARIOS, J.M., HONRUBIA, M. & MORENO, G. (1988). Estudio de los hongos que fructifican en la vegetación relicta de Abies pinsapo Boiss., en España peninsular. II. Ascomycotina. Acta Bot. Malacitana 13:91-110.

53).- LOSA ESPAÑA, T.M. (1949). Micromicetes del Pirineo español. Anales Jard. Bot. Madrid 8:297-338.

54).- LOSANTOS, A.P., BASCONES, J.C., EDERRA, A. & LÓPEZ-FERNANDEZ, M.L. (1983). Catálogo de Ascomycetes de Navarra. Publ. Biol. Univ. Navarra, Ser. Bot. 3:3-33.

55).- LUCAS, M.T. (1956). Fungi Lusitaniae. XIV. Agron. Lusit. 18(2):109-122.

56).- LUCAS, M.T. (1968). Culture studies on portuguese species of Leptosphaeria II. Trans. Brit. Mycol. Soc. 51(3/4): 411-415.

57).- LUCAS, M.T. (1971). Some Leptosphaeria and Pleospora species from the southern and south-western regions of Portugal. Mem. Soc. Brot. 21:33-47.

58).- LUCAS, M.T. & CÂMARA, M. SOUSA (1952). Fungi Lusitaniae. II. Agron. Lusit. 14(3): 193-227.

59).- LUCAS, M.T. & CÂMARA, M. SOUSA (1953). Fungi Lusitaniae. V. Agron. Lusit. 15(2): 153-182.

60).- LUCAS, M.T. & CÂMARA, M. SOUSA (1954). Fungi Lusitaniae. VIII. Agron. Lusit. 16(2):81-109.

61).- LUCAS, M.T. & CÂMARA, M. SOUSA (1955). Fungi Lusitaniae. XII. Agron. Lusit. 17(2/4):115-134.

62).- MALENÇON, G. & BERTAULT, R. (1976). Champignons de la Péninsule Ibérique.V. Catalogne, Aragon, Andalousie. Acta Phytotax. Barcinon. 19:1-68.

63).- MALENÇON, G. & LLIMONA, X. (1980). Champignons de la Péninsule Ibérique.VI. Est et sud-est. Anales Univ. Murcia Ci. 34(1-4):47-135.

64).- PETRAK, F. (1931). Mykologische Beiträge zur Flora von Spanien, Portugal und der Insel Madera. Ann. Mycol. 29:107-128. 1931

65).- REZENDE-PINTO, M.C. (1940). IV Contribuiçao para a flora criptogâmica do Norte de Portugal. Brotéria, Sér. Ci. Nat. 9(3): 113-130.

66).- RICK, J. (1905). Fungos dos arrededores de Torres Vedras. Brotéria, Sér. Bot. 4:159-163.

68).-SACCARDO, P.A. (1883). Sylloge Fungorum Omnium Hucusque Cogniturum. Vol. II. Patavii.

68).-SACCARDO, P.A. (1891). Sylloge Fungorum Omnium Hucusque Cogniturum. Vol. IX. Supplementum universale. Pars. I. Agaricaceae-Laboulbeniaceae. Patavii.

69).-SACCARDO, P.A. (1893). Florula mycologica lusitanica, sistens contributionen decimam ad eamden floram nec non conspectumfungorum omnium in lusitania hucusque observatorum. Bol. Soc. Brot. 11:9-70.

70).- SACCARDO, P.A. (1903). Florae Mycologicae Lusitanicae. Contributio duodecima. Bol. Soc. Brot. 19:156-171.

71).- SANTOS, A.C. (1956). Fungi Lusitaniae. XVII. Publ. Direcção Geral Serv. Florest. Aquíc. (Lisboa) 23(1):107-121.

72).- SANTOS, A.C. (1962). Notas sobre a micoflora de Portugal. I. Agron. Lusit. 24(4):257-271.

73).- SIERRA, M.D.(1987). Aportación al conocimiento de los Ascomycetes (Ascomycotina) de Cataluña.Edic. especials de la Societat catalana de Micologia. vol. 1. Barcelona.

74).- SIERRA, D. & CAMBRA, J. (1987). Notes micològiques I: Ascomicets del torrent de la Sequera (Tarragona). Butl. Soc. Catalana Micol. 11: 73-82.

75).- THÜMEN, F. (1879). Contributiones ad floram mycologicam lusitanicam. Series II. Instituto (Coimbra), Sér. 2, 27(6):251-259.

76).- THÜMEN, F. (1881). Contributiones ad floram mycologicam lusitanicam. Series III. Instituto (Coimbra), Sér. 2, 28(8): 359-370.

77).- TORRES JUAN, J. (1963). Los hongos del alcornoque en España. Anales Inst. Forest. Invest. 35(8):145-152.

78).- UNAMUNO, L.M. (1941). Enumeración y distribución geográfica de los Ascomicetos de la Península Ibérica y de las Islas Baleares. Mem. Real. Acad. Ci. Exact. Madrid 8:1-403.

79).- URRÍES, M.J. (1932). Datos sobre micromicetos de la provincia de Huesca. Bol. Soc. Esp. Hist. Nat. 32:213-229.

80).- URRÍES, M.J. (1933). Algunos datos para la flora española de micromicetos. Bol. Soc. Esp. Hist. Nat. 33:91-104.

81).- URRÍES, M.J. (1941). Datos para la flora española de micromicetos (segunda nota). Anales Jard. Bot. Madrid 1(1):59-78 [1940].

82).- URRÍES, M.J. (1942). Hongos microscópicos de Navarra. Anales Jard. Bot. Madrid 2:143-171.

83).- URRÍES, M.J. (1944). Hongos microscópicos del valle de Benasque (Pirineos aragoneses). Anales. Jard. Bot. Madrid. 4:167-193. 182.

84).- URRÍES, M.J. (1953). Notas micológicas. Anales Inst. Bot. Cavanilles 10(2):193-228.

85).- VASCONCELOS, A. TEIXEIRA (1951). "Lofionema helmintosporium". Uma nova espécie de "Pyrenomyceta"observada sobre Fraxinus sp., descrição macro e microscópica das fructificações observadas e critério seguido na sua classificação sistemática. Ass. Portug. Progr. Ci. XIII Congr. Lisboa 5:99-101.

86).- WINTER, G. (1884). Contributiones ad floram mycologicam lusitanicam. Series V. Bol. Soc. Brot. 2:32-57.

87).- WINTER, G. (1884). Contributiones ad floram mycologicam lusitanicam. Series V. Instituto (Coimbra), Sér. 2, 32(4): 195-200.

88).- WINTER, G. (1885). Contributiones ad floram mycologicam lusitanicam. Series VI. Bol. Soc. Brot. 3(1):50-64.

89).- WINTER, G. (1886). Contributiones ad floram mycologicam lusitanicam. Series VI. Instituto (Coimbra) 34(3):133-140.

CATALOGUE

Familia LOPHIOSTOMATACEAE Nitschke, Verh. Naturhist. Vereines Preuss. Rheinl. Westphalens 26. Corr. -Bl. 2: 74. 1869
Typus. -Lophiostoma Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 219 (1863).

= *Massarinaceae* Munk, Friesia 5: 305. 1956

CILIOPLEA Munk, Dansk Bot. Ark. 15(2): 113. 1953
Typus. -Cilioplea coronata (Niessl) Munk

Cilioplea coronata (Niessl) Munk, Dansk. Bot. Ark. 15: 113. 1953

≡ *Pleospora coronata* Niessl, Verh. Naturf. Vereins Brünn 14: 176. 1876
Typus. -(Lectotypus, M) Tschechoslowakei: Reseda lutea L., Brünn 9. 1875.
(Syntypus, M) Atriplex tatarica, Brünn, 8. 1875 (CRIVELLI, 1983: 172).
= *Pyrenophora coronata* (Niessl) Sacc., Syll. Fung. 2: 283. 1883

Chorology.- ESP: M (36). PRT: Ag (32,57), BAl (32,57), E (32,57).
Substrate.- *Carlina corymbosa, Centaurea sphaerocephala, Crucianella maritima, Malcomia littorea, Ononis natrix.*
Herbarium.- LISE.

Cilioplea kansensis (Ellis & Everh.) Crivelli, Diss. ETH, Zürich, n. 7318: 174. 1983

≡ *Pleospora kansensis* Ellis & Everh., J. Mycol. 8: 17. 1902
Typus. - In NY (Ellis & Everhart, n. 1636). U.S.A., Kansas, Rock Country, in Melilotus albae, 12-IV-1902 (CRIVELLI, 1983: 174).

Chorology.- PRT: E (61).
Substrate.- *Coronilla glauca*

ENTODESMIUM Riess, Hedwigia 1: 28. 1854
Typus. -Entodesmium rude Riess

Entodesmium rude Riess, Hedwigia 1(6): 28. 1854
Ind. Loc. -Germany, im Frühling 1853 an dürren Stengeln von Astragalus glycyphyllos und Orobus vernus in der Rähe von Raffel.

≡ *Ophiobolus rudis* (Riess) Rehm, Ber. Naturhist. Vereins Augsburg 26: 48. 1881

Chorology.- PRT: Ag (43,78), E (6,60).
Substrate.- *Asparagus albus, Lavandula stoechas, Ononis ramosissima.*

HERPOTRICHIA Fuckel, Fungi Rhenani exs. n.: 2171. 1868
Typus. -Herpotrichia rubi Fuckel, Fungi Rhenani exs. n. 2171 (1868) = H. herpotrichoides (Fuckel) Cannon, Trans. Brit. Mycol. Soc. 79: 338 (1982)

Herpotrichia juniperi (Duby) Petrak, Ann. Mycol. 23: 43. 1925

≡*Sphaeria juniperi* Duby, Herb. Mycol., n. 1833. 1854

Chorology.- ESP: Hu (18).
Substrate.- *Abies alba*
Herbarium.- AH

LOPHIOSTOMA Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 219. 1863
Typus. -Lophiostoma macrostomum (Tode: Fr.) Ces. & De Not.

= *Lophidium* Sacc., Michelia 1: 340. 1878

= *Lophiosphaera* Trevis., Bull. Soc. Roy. Bot. Belgique 16: 20. 1877

= *Platystomum* Trevis., Bull. Soc. Roy. Bot. Belgique 16: 16. 1877

= *Schizostoma* Ces. & De Not. ex Sacc., Michelia 1:. 1878

Lophiostoma appendiculatum Fuckel, Symb. mycol. Nachtr. 2: 29. 1873
Typus. - In S (isotype) Germany, Am Rheinufer bei Oestrich, auf faulenden Holz und noch berindeten Aesten von Salix. (HOLM, L. & HOLM, K. 1988: 10)

= *Lophiotrema auctum* Sacc., Syll. Fung. 2: 688. 1883

Chorology.- ESP: J (50), M (17). PRT: E (28).
Substrate.- *Thymus vulgaris, Nepeta tuberosa.*
Herbaria.- JL, HJCh.-GM.

Lophiostoma caudatum Fabre, Ann. Sci. Nat., ser. 6, 9: 103. 1879
Ind. Loc. -France, Vaucluse, ad caules exsiccatos denudatosque Paliuri aculeati (=P. spina-Christi). Martio.

= *Lophiostoma prominens* Nitschke, Syst. Bearb. Pyr. Loph.: 38. 1886

Chorology.- ESP: Mu (46).
Substrate.- Dead wood without identification.
Herbarium.- MHG.

Lophiostoma caulium (Fr.: Fr.) Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 219. 1863

≡ *Sphaeria caulium* Fr.: Fr., Syst. mycol. 2: 509. 1823
Typus. -In UPS. Sweden, Skåne, ad caules siccos Urticae & c., vere. (UPS, lectotype, HOLM, L. & HOLM, K., 1988: 11).

= *Lophiostoma niessleanum* Sacc., Michelia 1: 447. 1878

= *Lophiostoma parvulum* Nitschke, Syst. Bearb. Pyr. Loph.: 42. 1886

= *Lophiostoma salsolae* Urries, Anales Jard. Bot. Madrid 1: 66. 1941
Typus. -In Ma-Fungi (11604), Spain, Madrid, La Poveda, in ramulis Salsolae sp. 15-V-1933, M. Jordán de Urríes.

= *Lophiostoma caulium* f. *santolinae* Urries, Bol. Soc. Esp. Hist. Nat. 32(4): 218. 1932
Typus. -In MA-Fungi (9757-9758). Spain, Huesca, Barbuñales, in radicibus aridis Santolinae chamaecypparissus, 7-VIII-1931, J. de Urríes.

= *Lophiostoma insidiosum* (Desm.) Ces. & De Not., Comm. Soc. Critt. Ital. 1: 220. 1863

Chorology.- ESP: Al (50), Ge (77), Gu (16), Hu (18,78,79,80,83), M (2,16,18,78,79,80,81,83), Na (82), Sg (16,19). PRT: Ag (32), BL (12), E (12,14,28,71).
Substrate.- *Abies alba, Achillea agerati, Artemisia glutinosa, Artemisia sp., Aster acris, Crithnum maritimum, Galium sylvestre, Genista scorpius, Helichrysum stoechas, Inula viscosa, Juniperus thurifera, Nepeta tuberosa, Phagnalon saxatile, Quercus coccifera, Quercus rotundifolia, Quercus suber, Salsola vermiculata, Salvia lavandulaefolia, Santolina chamaecyparisus, Thymus sp., Urtica dioica.* Wood without identification.
Herbaria.- AH, HJCh.-GM, JL, LISE, MA-Fungi.

Lophiostoma compressum (Pers.: Fr.) Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 219. 1863

≡*Sphaeria compressa* Pers.: Fr., Syst. mycol. 2: 470. 1823
Typus. -Lectotype: Herb. Persoon no. 910. 270-358 (CHESTERS & BELL, 1970: 48). Ad ligna frequens. Pers annum (v. v.)

Platystomum compressum (Pers.: Fr.) Trevis., Bull. Soc. Roy. Bot. Belgique 16: 16. 1877
Lophidium compressum (Pers.: Fr.) Sacc., Michelia 1: 340. 1878

= *Platystomum nobile* Sacc. & D. Sacc., Syll. Fung. 17:. 1905

= *Platystomum compressum* var. *septemseptata* Sacc., Syll. Fung. 2: 711. 1883

Chorology.- ESP: A (46), Gu (16), Hu (78,79,83), L (73), M (16), Mu (46), Na (35,54,82), Sg (16,19). PRT: E (10,20,26,58,60,78).
Substrate.- *Asparagus albus, Coridothymus capitatus, Corylus avellana, Crataegus monogyna, Fraxinus sp., Genista scorpius, Helichrysum stoechas, Jasminum fruticans ?, Lavandula stoechas ssp. pedunculata, Lonicera etrusca, Myoporum acuminatum, Pistacia lentiscus, Populus canadense, Prunus mahaleb, Quercus ilex, Quercus pubescens, Rosmarinus officinalis, Rubus sp., Rubus ulmifolius,*

Salix sp., Salvia lavandulaefolia, Smilax aspera, Thymus sp. On unidentified dead wood.

Herbaria.- AH, DSL, HJCh-GM, LISE, MHG.

Lophiostoma fuckelii Sacc., F. Ital., tab. 254. 1878

Ind. Loc. -Germany, pr. Eberbach, Rubus fruticosus.

Chorology.- ESP: T (74).

Substrate.- Decayed branches.

Herbarium.- BCC-DSL.

Lophiostoma macrostomoides (De Not.) Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 219. 1863

≡ *Sphaeria macrostomoides* De Not., Mem. Accad. Sci. Torino, ser. 2, 13: 111. 1854

Typus. -In RO, Lectotype. Italy, prov. Milano, old bark of Salix alba, 16-X-1838, De Notaris.

= *Platystomum compressum* var. *pseudomacrostomum* (Sacc.) Chesters & Bell, Mycol. Pap. 120: 49. 1970

Chorology.- ESP: Gu (17), Hu (81), J (50), M (17), Sg (19). PRT: E (20).

Substrate.- *Arbutus unedo, Arctostaphylos uva-ursi, Artemisia campestris, Cytisus reverchonii, Lavandula angustifolia, Lavandula stoechas ssp. pedunculata, Populus canadensse, Populus sp., Rubus sp., Thymus sp., Thymus vulgare.*

Herbaria.- AH, HJCh.-GM, JL, MA-Fungi.

Lophiostoma macrostomum (Tode: Fr.) Fuckel, Symb. mycol.: 157. 1870

≡ *Sphaeria macrostoma* Tode: Fr., Syst. mycol. 2: 469. 1823

Typus. -In UPS, lectotype, ad ligna, sarmenta & cortices, passim. Perennis (v. v.). prop.: "Sphaeria macrostoma Femsjö", scr. Fries.

= *Lophiostoma anaxaeum* Sacc., Hedwigia 14: 69. 1875

Ind. Loc. -Italy, Piave (Anaxi) a Narvesa (Treviso), in caule rammisque Artemisiae camphoratae in alveo fluminis. Aug. 1873.

Lophiosphaera anaxaea (Sacc.) Trevis., Bull. Soc. Roy. Bot. Belgique 16: 20. 1877

= *Lophiostoma pinastri* (Niessl) Rabenh., Krypt. Flor.: 298. 1887

= *Lophiotrema praemorsum* (Lasch) Sacc., Michelia 1: 338. 1878

= *Lophiostoma praemorsum* Lasch ex Fuckel, Symb. mycol.: 157. 1870

= *Lophiostoma angustilabrum* (Berk. & Broome) Cooke, Trans. Bot. Soc. Edinburgh 9: 330. 1868

= *Sphaeria crenata* Pers.: Fr., Syst. mycol. 2: 469. 1823
Lophiotrema crenatum (Pers.: Fr.) Sacc., Michelia 1: 338. 1878

Chorology.- ESP: B (73), Gr (48), Hu (53,78,79,80), M (16), Mu (46), Southeast of Spain (47). PRT: Ag (43,78), AAl (27), BL (70,78), E (14,17,26,28,29,30,31), R (30).
Substrate.- *Acacia sp., Artemisia crithmifolia, Artemisia herba-alba, Artemisia barrelieri, Cistus ladanifer, Cytisus sp., Geitonoplesium cymosum, Helichrysum stoechas, Lonicera sp., Pinus halepensis, Pinus pinaster, Rubus sp., Teucrium sp., Typha angustifolia, Ulex parviflorus.* Unidentified wood.
Herbaria.- AH, DSL, JL, HJCh.-GM, LISE, MA-Fungi, MHG.

Lophiostoma quadrinucleatum P. Karst., Mycol. Fenn. 2: 85. 1873
Typus. -In H. Finland, Mustiala. In ligno ramorum Rhamni Frangulae mense Junio.

Chorology.- ESP: Hu (18).
Substrate.- *Buxus sempervirens.*
Herbaria.- AH, MA-Fungi.

Lophiostoma quadrinucleatum var. **triseptatum** (Peck) Chesters & Bell, Mycol. Pap. 120: 36. 1970

= *Lophiostoma triseptatum* Peck, N. Am. Pyrenom.: 224. 1892
Ind. Loc. -Lindonville, Acer, leg. Fairman, 1-8-1890. N. 184

Chorology.- ESP: B (73), Gu (17), M (17), Ma (51), Sg (16,17). PRT: BL (4,78), E (5).
Substrate.- *Casuarina sp., Cistus salvifolius, Cupressus sp., Eleagnus umbellata, Eucalyptus globulus, Fagus sylvatica, Pinus pinaster, Quercus ilex ssp. rotundifolia, Rhamnus alaternus, Salvia lavandulaefolia, Ulex baeticus.*
Herbaria.- DSL, HJCh-GM, JL.

Lophiostoma semiliberum (Desm.) Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 220. 1863

≡ *Sphaeria semiliberum* Desm., Ann. Sci. Nat. Bot., ser. 3, 6: 78. 1846
Typus. -In UPS, Isotype. France, Caen, Bromus sylvaticus (=Brachypodium s.) leg. Roberge. (HOLM, L. & HOLM, K., 1988: 23).
Lophiotrema semiliberum (Desm.) Sacc., Michelia 1: 338. 1878

Chorology.- PRT: BL (86,78).
Substrate.- *Piptatherum multiflorum*

Lophiostoma subcorticale Fuckel, Symb. mycol.: 157. 1870
Typus. -In S isotype. Germany, Oestrich, an der inneren Fläche noch hängender, alter Rinde von Pyrus Malus, nicht selten, das ganze Jahr.

Chorology.- ESP: Ca (52).
Substrate.- *Quercus faginea*

Herbarium.- JL

Lophiostoma vicinum (Sacc.) Sacc., F. Ital. tab.: 239. 1878

≡ *Schizostoma vicinum* Sacc., Michelia 1: 337. 1878
Typus. -In PAD. Italy, Montello, oak bark, IX-1875. (HOLM, L. & HOLM, L., 1988: 24).

= *Lophiostoma montellicum* ssp. *vicinum* Sacc., Michelia 1: 44. 1877

Chorology.- ESP: Hu (18), Mn (23), Po (44,78).
Substrate.- *Buxus sempervirens, Quercus ilex, Quercus pedunculata.*
Herbarium.- AH.

Lophiostoma viridarium Cooke, Trans. Bot. Soc. Edinburg 9: 328. 1868
Ind. Loc. -England, Surrey, Shere, "on decorticated twigs of Maple", Jan. 1866, leg. Capron. (HOLM, L. & HOLM, K. 1988: 24).

= *Lophiostoma desmazierii* Sacc. & Speg., Michelia 1: 411. 1878

Chorology.- ESP: B (73), T (73). PRT: E (8,10,20,78).
Substrate.- *Erica multiflora, Acer sp., Arbutus unedo, Myrica faya, Myrtus communis, Rhamnus sp.*
Herbarium.- DSL.

Lophiostoma winteri (Sacc.) G. Winter, Krypt. -Fl. 2. Aufl. 1(2): 297. 1885

≡ *Lophiotrema winteri* Sacc., Michelia 1: 358. 1878
Typus. -In UPS. Switzerland, pr. Zürich, dead stems of Helianthemum Chamaecistus (=H. nummularium), VIII-1878, leg. Winter (=Kze, F. sel. 340). (HOLM, L. & HOLM, K., 1988: 24).

Chorology.- ESP: Ab (50), M (16). PRT:(75,78)
Substrate.- Artemisia campestris, Cistus salvifolius. *On branch.*
Herbaria.- JL, HJCh.-GM.

LOPHIOTREMA Sacc. emend. L. Holm & K. Holm, Symb. Bot. Upsal. 28(2): 25. 1988
Typus. -Lophiotrema nucula (Fr.: Fr.) Sacc.

Lophiotrema culmifragum Speg.

Chorology.- PRT: BL (68,78,87).
Substrate.- *Arundo donax*

Lophiotrema nucula (Fr.: Fr.) Sacc., Michelia 1: 338. 1878

≡ *Sphaeria nucula* Fr.: Fr., Syst. mycol. 2: 466. 1823
Typus. -In UPS, Lectotype prop.: Fr. Scl. suec. 238 (HOLM, L. & HOLM, K, 1988: 26),

ad corticem crassiorem Quercus & c. Perennis (v. v.).
Lophiostoma nucula (Fr.: Fr.) Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 220. 1863

= *Lophiostoma duplex* P. Karst., F. Fenn., exs. n. 970. 1870
Lophiotrema duplex (P. Karst.) Sacc., Michelia 1: 338. 1878

Chorology.- ESP: M (16), Z (84).
Substrate.- *Artemisia herba-alba, Salix sp.*
Herbarium.- HJCh-GM.

Lophiotrema vagabundum (Sacc.) Sacc., Michelia 1: 338. 1878

≡ *Lophiostoma vagabundum* Sacc., Hedwigia 14: 70. 1875
Ind. Loc. -Italy, Montello (Treviso), in caulibus herbarum variarum, autumno.

Chorology.- PRT: R (29).
Substrate.- *Phagnalon saxatile.*
Herbarium.- LISE

MASSARINA Sacc., Syll. Fung. 2: 153. 1883
Typus. -Massarina eburnea (Tul. & C. Tul.) Sacc.

Massarina arundinacea (Sowerby: Fr.) Leuchtm., Sydowia 37: 179. 1985

≡ *Sphaeria arundinacea* Sowerby: Fr., Syst. mycol. 2: 429. 1823
Ind. Loc. -In culmis arundinaceis denudatis nec epidermide tectis, ut S. rimosa, copiose in Kamtschatka; & America boreali in Arundinaria macrosperma. Vere.

Leptosphaeria arundinacea (Sowerby: Fr.) Sacc., Nuovo Giorn. Bot. Ital. 7: 320. 1875

Chorology.- PRT: BL (86,87), without locality (56).
Substrate.- *Arundo donax, Phragmites communis.*
Herbarium.- LISE

Massarina cisti Bose, Phytopathol. Z. 41: 163. 1961
Typus. -In ETH (Pure Culture Collection n. 2937) France, Plan d'Aups, dead decorticated of Cistus albidus L., June 6, 1959, leg. R. Hütter and W. Loefler.

Chorology.- ESP: Ma (52), Mu (50).
Substrate.- *Cistus albidus, Cistus sp.*
Herbarium.- JL.

Massarina corticola (Fuckel) L. Holm, Symb. Bot. Upsal. 14: 147. 1957

≡ *Trematosphaeria corticola* Fuckel, Symb. mycol.: 162. 1870 Typus. -In S. Germany, auf der Münchau bei Hattenheim, auf alter Rinde von Ulmus campestris,

Chorology.- PRT: E (29).
Substrate.- *Hypericum* sp.
Herbarium.- LISE.

Massarina eburnea (Tul. & C. Tul.) Sacc., Syll. Fung. 2: 153. 1883

≡ *Massaria eburnea* Tul. & C. Tul., Sel. Fung. carp. 2: 239. 1863

Chorology.- ESP: Z (62).
Substrate.- *Populus* sp.

Massarina papulosa (Durieu & Mont.) Bose, Phytopathol. Z. 41: 176. 1961

≡ *Sphaeria papulosa* Durieu & Mont., Flore d'Algerie 1: 536. 1846
Leptosphaeria papulosa (Durieu & Mont.) Sacc., Nuovo Giorn. Bot. ital. 7: 313. 1875
Metasphaeria papulosa (Durieu & Mont.) Sacc., Syll. Fung. 2: 168. 1883

= *Leptosphaeria pinnarum* Pass., Rev. Mycol. 2: 34. 1880
= *Leptosphaeria spatharum* Ces., Fungi euopaei exsiccati, ser. 2, cent. 26, n. 2530. 1881
Metasphaeria spatharum (Ces.) Sacc., Syll. Fung. 2: 179. 1883

= *Metasphaeria viridarii* Sacc., Syll. Fung. 9: 838. 1891

= *Sphaeria anisometra* Cooke & Harkn., Grevillea 9: 86. 1881
Metasphaeria anisometra (Cooke & Harkn.) Sacc., Syll. Fung. 2: 163. 1883

Chorologya.- ESP: A (33), B (73), C (78), Ge (73), Mu (50), S (78), T (73). PRT: BL (1,69,70,78), E (7,31,55,58,60,61,72,78), Mi (59).
Substrate.- *Acacia cyanophylla, Arundo donax, Callistemon phoeniceus, Chamaerops excelsa, Chamaerops humilis, Corylus avellana, Cupressus lusitanica, Eucalyptus globulus, Eucalyptus sp., Evonymus japonicus, Lavandula stoechas, Lonicera caprifolium, Lonicera implexa, Lonicera periclymenum, Lonicera sp., Menispermum canadense, Persica vulgaris, Phoenix dactilifera, Rhododendron ferrugineum, Rubus sp., Solanum sp., Spartium junceum, Tamarix gallica.*
Herbaria.- DSL, GD, JL, LISE, LISFA, MA-Fungi.

MASSARIOSPHAERIA (E. Müll.) Crivelli, Diss ETH, Zürich, n. 7318: 141. 1983
Typus. -Massariosphaeria phaeospora (Müller) Crivelli, Diss. ETH, Zürich, n. 7318: 141 (1983).

Massariosphaeria alpigena (Fuckel) L. Holm & K. Holm, Symb. Bot. Upsal. 28(2): 29. 1988
Typus. -In S (isotype). Switzerland, pr. Neuchâtel, twigs of Lonicera alpigena, X. 1869, leg. Morthier (HOLM, L. & HOLM, K., 1988: 29).

≡ *Lophiostoma alpigenum* Fuckel, Symb. mycol.: 157. 1870

Typus. -(S isotype). Auf dürren berideten Zweigen von Lonicera alpigena, im Winter. Bei Neuchatel von Morthier entdeckt (Switzerland), X-1869.

Chorology.- ESP: M (17), Ma (51), Sg (19).
Substrate.- *Quercus rotundifolia, Populus canadense, Salvia lavandulaefolia.*
Herbaria.- AH, HJCh-GM, JL.

Massariosphaeria rubicunda (Niessl) Crivelli, Diss ETH, Zürich, n. 7318: 144. 1983

≡ *Pleospora rubicunda* Niessl, Verh. Naturf. Vereins Brünn 14: 191. 1876
Typus. -In M. Tschechoslowakei, auf Juglans regia L., Brünn. (CRIVELLI, 1983: 144).

Chorology.- ESP: M (36,78). PRT: E (26).
Substrate.- *Juncus sp., Scirpus holoschoenus.*
Herbarium.- LISE.

Massariosphaeria straminis (Sacc. & Speg.) Crivelli, Diss. ETH, n. 7318: 148. 1983

≡ *Pleospora straminis* Sacc. & Speg., Michelia 1: 407. 1879
Typus. - In PAD ?. Saccardo Herb. n. 2753. (CRIVELLI, 1983: 149).

Chorologia.- PRT:E (26).
Substratum.- *Scirpus holoschoenus.*
Herbarium.- LISE.
Observations: In the publication, these specimens have the same herbarium number (LISE 62925) as the previous species.

TRICHOMETASPHAERIA Munk, Dansk Bot. Ark. 15(2): 135. 1953
Typus.- Trichometasphaeria dianthi (Rostr.) Munk, Dansk Bot. Ark. 15(2): 135. 1953

= Keissleriella Höhnel, Sber. K. Akad. Wiss. Wien, match. -naturw. Kl., Abt. I. 128: 592. 1919
Typus. -Keissleriella aesculi (Höhnel) Höhnel (=K. cladophila (Niessl) Corbaz), Sitzber. Akad. Wiss. Wien, Math. -natur. Kl. 128: 582 (1919) (BOSE, 1961:179).

Trichometasphaeria culmifida (P. Karst.) L. Holm, Symb. Bot. Upsal. 14(3): 140. 1957

≡ *Leptosphaeria culmifida* P. Karst., Mycol. Fenn. 2: 103. 1873
Typus. -In UPS (F. fenn. 961). Finland, in culmis putrescentibus Phlei pratensis.

Keissleriella culmifida (P. Karst.) Bose, Phytopathol. Z. 4: 188. 1961

= *Metasphaeria culmifida* (P. Karst.) Sacc., Syll. Fung. 2: 174. 1883

Chorology.- ESP: Ge (39).
Substrate.- *Phleum pratense*

Trichometasphaeria gloeospora (Berk. & Curr.) L. Holm, Symb. Bot. Upsal. 14(3): 144. 1957

≡ *Sphaeria gloeospora* Berk. & Curr., Ann. Mag. Nat. Hist., ser. 3, 7: 454. 1861
Typus. -In K. Great Britain (Fleetwood), Artemisia absinthium, leg. A. Bloxam (HOLM, L. 1957: 144).

Keissleriella gloeospora (Berk. & Curr.) Bose, Phytopathologische Zeitschrift 41: 190. 1961

= *Trichometasphaeria dianthi* (Rostr.) Munk, Dansk Bot. Ark. 15(2): 135. 1953

= *Sphaeria comatella* Cooke & Ellis, Grevillea 5: 52. 1876
Leptosphaeria comatella (Cooke & Ellis) Sacc., Syll. Fung. 2: 32. 1883

Chorology.- ESP: Hu (53). PRT: BA (9,78).
Substrate.- *Verbascum thapsus*

DOUBTFUL AND EXCLUDED TAXA

? = Doubtful taxa
# = Excluded taxa

? **Entodesmium nevadense** Petrak, Ann. Mycol. 29: 109. 1931
Ind. Loc. -Spanien, Nordseite des Dornajo in der Serra Nevada, ca. 20000 m, auf faulenden Stengeln von Carduus granatensis. 2-VI-1929.

Chorology.- ESP: Gr (64,78).
Substrate.- *Carduus granatensis*
Observations: By the spore measurements (4,5-9 x 2-2,5 mm) this species is not well placed in the genus *Entodesmium*.

? **Herpotrichia molleriana** G. Winter, Bol. Soc. Brot. 3(1): 54. 1885
Typus .- In COI (835). Ind. Loc. -Portugal, Rica-fé, Bragança, in Quercus Suberis L. foliis vivis, 6. 84 (1884) Altit 710 m.N. 2462. leg. Moller.

Chorology.- PRT: TM (88,89). Without locality (65).
Substrate.- *Quercus suber*, *Gerarium rotundifolium.*
Herbarium.- COI

? **Lophidium aromaticum** Fabre, Ann. Sci. Nat., ser. 6, 9: 100. 1878
Ind. Loc. -Ad ramos exaridos et decorticatos variorum fruticum aromaticorum, sicut: Thymus vulgaris, Lavandula spica, Rosmarinus officinalis, Santolina Chamaecyparissus. Pariter invenitur in sequentibus: Genista Scorpius, Rhamnus infectorius, Jasminum fruticans. Per annum.

Chorology.- PRT: Ag (11,14,28).
Substrate.- *Jasminum fruticans, Coridothymus capitatus.*

Herbarium.- LISE

Observations: The specimen of *Coridothymus capitatus* (LISE 65678) is *Lophiostoma compressum* (Pers.:Fr.) Ces. & De Not.

? **Lophidium budleiae** Sousa da Câmara & A.T. Vasconc., Agron. Lusit. 17(2/4): 94. 1955
Ind. Loc. - Portugal, Alenquer, Serra de Montejunto, in ramis siccis Budleiae sp., leg. Teixeira de Vasconcelos, septembri 1953.

Chorology.- PRT:E (15,24).
Substrate.- *Budleia* sp.

Observations: The type is lost. The genus *Lophidium* is now *Lophiostoma*. The description is doubtful, but probably is *Lophiostoma compressum* (Pers.:Fr.) Ces. & De Not.

# **Lophionema helminthosporium** A.T. Vasconc., XIII Congr. Ass. Portug. Progr. Ci. & XX Congr. Ass. Esp. Prog. Ci 5: 101. 1951
Typus. -In LISE (62781). Portugal, Estremadura, Queluz (Mata), in ramulis Fraxini sp., 1950 Maio.

Chorology.- PRT:E (85).
Substrate.- *Fraxinus* sp.
Herbarium.- LISE

Observations: This species has apothecia dark, with a broad protuberent apical papila. Hyaline, multiseptate and filiform spores (300 x 1,5-2 mm). Is really *Ostropa barbara* (Fr.) Nannfeldt.

? **Lophiosphaera camarae** Dias, Agron. Lusit. 18(4): 239. 1956
Typus. -In LISE (n. 62798). Portugal, Estremadura, Sacavém (EAN), in ramulis Spartii juncei L., 1955 Januario 24, M.R.S. Dias.

Chorology.- PRT: E (25).
Substrate.- *Spartium junceum*
Herbarium.- LISE

Observations: The type specimens are immature.

# **Lophiostoma demissum** Nitschke, Nova Acta 50(2): 53. 1886

Chorology.- ESP: Or (45,78).
Substrate.-*Plantago lanceolata.*
Herbarium.- MA-Fungi.

Observations: This specimen is a *Hypoderma* sp.

? **Lophiostoma ericarum** Fabre

Chorology.- ESP: Hu (78,81), Na (35,82).
Substrate.- *Arctostaphylos uva-ursi.*
Herbarium.- Ma-Fungi.

Observations: The specimen of Huesca (Hu) (URRIES, 1941) is *Lophiostoma macrostomoides* (De Not.) Ces. & De Not. The other is lost.

# **Lophiostoma niessleanum** f. **asteris-alpini** Gonz. Frag., Butl. Inst. Catalana Hist. Nat. 24: 128. 1924
Typus. -In Ma-Fungi (6574), Spain, Lérida, Circ de Moreus, in foliis Asteris alpini, 18-VIII-1922, Cuatrecasas

Chorology.- ESP: L (42,78).
Substrate.- *Aster alpinus.*
Herbarium.- MA-Fungi.

Observations: Is a *Nodulosphaeria* sp. The spores are 5- septate; the first septum is supramedian with a enlarged cell above (38-42 x 9-19 mm). There are not any species with this description (SHOEMAKER, 1984, HOLM. 1957), by this reason a new combination is proposed; *Nodulosphaeria asteris-alpini* (Gonz.Frag.) Checa, nov. comb.

# **Lophiostoma rhopaloides** Sacc., Fung. ital., n. 237. 1878

Chorology.- PRT: TM (41,78).
Substrate.- *Castanea vulgaris.*
Herbarium.- MA-Fungi.

Observations: Is *Teichospora trabicola* Fuckel.

? **Lophiostoma sedi** Fuckel, Symb. mycol.: 155. 1870

≡ *Lophiotrema sedi* (Fuckel) Sacc., Michelia 1: 338. 1878
Ind. Loc. -An dürren Stengeln von Sedum reflexum, sehr selten, im Frühling. Oberhalb Hallgarten.

Chorology.- ESP: M (?) (78).
Substrate.- *Umbilicus pendulinus, Poterium sanguisorba.*

? **Lophiostoma sp.** Larios, Honrubia & G. Moreno, Acta Bot. Malacitana 13: 96. 1988

Chorology.- ESP: Ma (52).
Substrate.- Wood without identification.
Herbarium.- JL.

Observations: The type specimen is not available.

# **Lophiostoma stuartii** Fabre, Ann. Sci. Nat., ser. 6, 9: 102. 1878
Typus. - In P. Ad ramos exaridos decorticatosque Thymi vulgaris et Rosmarini officinalis. Hyeme.

Chorology.- PRT: E (26).
Substrate.- *Teucrium* sp.
Herbarium.- LISE.

Observations: These specimens corresponds to *Lophiostoma macrostomum* (Tode:Fr.) Ces. & De Not.

? **Lophiostoma ulicis** Nitschke. 1886

Chorology.- ESP: Se (37,78).
Substrate.- *Ulex baeticus*

# **Lophiostoma vagans** Fabre, Ann. Sci. Nat., ser. 6, 9: 103. 1878
Ind. Loc. -Ad caules et ramos varios. Per annum.

Chorology.- PRT: Ag (32).
Substrate.- *Crithnum maritimum.*
Herbarium.- LISE.

Observations: These specimens corresponds to *Lophiostoma caulium* (Fr.:Fr.) Ces. & De Not.

# **Lophiotrema bolivarii** Gonz. Frag., Bol. Soc. Esp. Hist. Nat. 17: 304. 1917
Typus. -In MA-Fungi (2326). Spain, Málaga, in basi petiolis
Phoenicis canariensis, cultivada, 29-XII-1916, C. Bolívar.

Chorology.- ESP: Ma (38,78).
Substrate.- *Phoenix canariensis.*
Herbarium.- MA-Fungi.

Observation: These specimens represent a *Patellaria* sp.

? **Lophiotrema mollerianum** (G. Winter) Berl. & Voglino, Syll. Fung. add vol. 1-4,. 1886

≡ *Lophiostoma mollerianum* G. Winter, Bol. Soc. Brot. 2: 44. 1884
Typus.- In COI (753). Ind. Loc. -Portugal, Baleia, Coimbra, ad Quercus cocciferae L. folia viva. 2. 83 (1883), N. 2152, leg. Moller.

Chorology.- PRT: BL (68,78,87).
Substrate.- *Quercus coccifera*
Observations: The specimen type is not a *Lophiostoma.*

? **Lophiotrema pteridis** Gonz. Frag., Bull. Soc. Mycol. France 36: 105. 1920
Typus. -In MA-Fungi (3760). Spain, Madrid, Estación Alpina de Biología (Navacerrada), in frondibus siccis Pteridis aquilinae, 15-V-1916, C. Bolívar.

Chorology.- ESP: M (40,78).
Substrate.- *Pteridium aquilinum*
Herbarium.- MA-Fungi.

Observation: Is *Leptosphaeria* sp.

? **Massarina dianthi** Fern. Riofrio, Mem. Real Soc. Esp. Hist. Nat. 15(1): 386. 1929
Ind. Loc. -España, Huesca, Campo, in ramis siccis et foliis Dianthi monspessulani.

Chorology.- ESP: Hu (34,78).
Substrate.- *Dianthus monspessulanus.*

# **Metasphaeria papulosa** f. **limbalis** Gonz. Frag., Mem. Real Soc. Esp. Hist. Nat. 11: 89. 1919
Typus. -In Ma-Fungi (3285). Spain, Barcelona, Centellas, in foliis adhuc vivis Buxi sempervirentis, IV-1918, Prof. Caballero.

Chorology.-ESP: B (39,78)
Substrate.- *Buxus sempervirens*
Herbarium.- MA-Fungi

Observations: Is *Mycosphaerella buxicola* (Fr.) Tomilin.

? **Platystomum bupleuri** Urries, Bol. Soc. Esp. Hist. Nat 32: 221. 1932
Typus. -In MA-Fungi (9753-9754). Spain, Huesca, Barbuñales, in ramulis siccis Bupleuri fruticescentis. 13-IX-1931, J. de Urríes.

Chorology.-ESP: Hu (78,79)
Substrate.-*Bupleurum fruticescens*
Herbarium.- MA-Fungi.

Observations: In the material there are not any specimens with the characters that URRIES (1932) indicated. The specimens are close to *Lophiostoma compressum* (Pers.:Fr.) Ces. & De Not.

# **Sampaioa** Gonz. Frag., Bol. Soc. Brot., Sér. 2, 2: 32. 1923
Typus. -Sampaioa pinastri Gonz. Frag.

Observations: This genus is accepted in the family *Lophiostomataceae* (ERIKSSON & HAWKSWORTH, 1993, HAWKSWORTH & al., 1995). However, the type specimen is *Mycoglaena acuminans* (Nyl.) Vainio.

# **Sampaioa pinastri** Gonz. Frag., Bol. Soc. Brot., Sér. 2, 2: 32. 1923
Typus. -In MA-Fungi (5257). Portugal, Povoa de Lanhoso; S. Gens, in cortice ramulorum Pini pinastri, IX-1919, leg. Prof. Dr. G. Sampaio.

Chorology.- PRT: Mi (41,78).
Substrate.- *Pinus pinaster*.
Herbarium.- MA-Fungi.

? **Schizostoma microsporum** Pass.

Chorology.- ESP: Ma (62).
Substrate.- *Ulex baeticus*.

The genus is now *Lophiostoma*, but this species has not been synonymized and the spanish material is lost.

MYTILINIDIACEAE Kirschst., Verh. Bot. Vereins Prov. Branderburg 66: 28. 1924
Typus. -Mytilinidion Duby, Mém. Soc. Phys. Genève 16: 34 (1862).

= *Lophiaceae* H. Zogg ex Arx & E. Müll., Stud. Mycol. 9: 69. 1975

ACTIDIUM Fr.: Fr., Syst. mycol. 2: 595. 1823
Typus. -Actidium hysterioides Fr.: Fr.

Actidium hysterioides Fr.: Fr., Syst. mycol. 2: 596. 1823
Typus. -In Herb. Neuenburg (Scler. suec. n. 63) (Zogg 1962: 125). Ad ligna decorticata abiegna, hieme, vere (v. v).

Chorology.- ESP: M (22).
Substrate.- *Pinus sylvestris*.
Herbarium.- HJCh.-GM.

Actidium nitidum (Ellis) H. Zogg, Ber. Schweiz Bot. Ges. 70: 195. 1960

≡ *Glonium nitidum* Ellis. 1879

Chorology.- ESP: Sg (19).
Substrate.- *Juniperus thurifera*
Herbarium.- AH.

GLYPHIUM Nitschke ex Lehman, Nova Acta Acad. Caes. Leop. -Carol. German. Nat. Cur. 50: 139. 1886
Typus. -Glyphium elatum (Grev.) Zogg

Glyphium elatum (Grev.) H. Zogg, Beitr. Kryptogamenfl. Schweiz 11(3): 99. 1962

≡ *Lophium elatum* Grev., Scottish cryptogamic Flora, tab. 177. 1825
Ind. Loc. -N. d.

Chorology.- ESP: Ca (3).
Substrate.- *Abies pinsapo*

LOPHIUM Fr.: Fr., Syst. mycol. 2: 534. 1823
Typus. -Lophium mytilinum (Pers.: Fr.) Fr.

Lophium mayori H. Zogg, Ber. Schweiz. Bot. Ges. 62: 291-295. 1952
Typus. -In Z. Switzerland, Kt. Graubünden, Albulatal, zwischen Bergün und Preda, Val Rots, oberhalb Punt-Ota, ca. 1760 m.ü.M. ; in Larix decidua (altes Holz), 27 August 1940; leg. H.
Zogg. (ZOGG, 1962: 97).

Chorology.- ESP: Mu (49).
Substrate.- *Pinus pinaster*
Herbarium.- MUB.

Lophium mytilinum (Pers.: Fr.) Fr., Syst. mycol. 2: 533. 1823
≡ *Hysterium mytilinum* Pers.: Fr., Syst. mycol. 2: 533. 1823
Ind. Loc. -Ad cortices ligna & acus Pinuum; "Juglandis carolinae". Perennis (v. v.).

Chorology.- ESP: Ca (51), Gu (16,21), Hu (18), M (16,21), Ma (51,62), Sg (16), T (74), southeast of Spain (49). PRT: Mi (18).
Substrate.- *Abies alba, Abies pinsapo, Juniperus thurifera, Pinus halepensis, Pinus pinaster, Pinus sylvestris.*
Herbaria.- AH, BCC-DSL, HJCh.-GM, JL, MA-Fungi.

MYTILINIDION Duby, Mèm. Soc. Phys. Genève 16: 34. 1862
Typus. -Mytilinidion mytilinellum (Fr.: Fr.) Zogg, Beitr. Kryptogamenfl. Schweiz 11(3): 106

Mytilinidion gemmigenum Fuckel, Jahrb. Nassauischen Vereins Naturk. 25: 299. 1871
Typus. -(Herb Fuckel in Herb. Barbey-Boissier, Stockholm). Fast stets an den dürren Knospen oder eigentlich an den Rudimenten der abgefallen Nadeln und sehr selten an der Rinde der Aestchen von Larix europaea, sehr selten, perennirend, im Frühling mit jugendlichen Schläuchen und Sporen. An der oberen Mittelheimer Aepfelbach.

Chorology.- ESP: Gr (63).
Substrate.- *Ulex parviflorus.*

Mytilinidion rhenanum Fuckel, Symb. mycol. Nachtr. 1: 10(298) -11(299). 1871

Chorology.- ESP: Gu (16,17), M (17).
Substrate.- *Pinus sylvestris.*
Herbarium.- HJCh-GM.

Mytilinidion tortile (Schwein.) Ellis & Everh., N. Am. Pyren.: 688. 1892

≡ *Hysterium tortile* Schwein., Schriften Naturf. Ges. Leipzig 1:. 1822
Typus. -In Kew (BISBY, 1932:322).

Chorology.- ESP: Ca (51), Gu (16), Ma (51), Sg (16).
Substrate.- *Abies pinsapo, Juniperus thurifera.*
Herbaria.- AH, HJCh-GM.

DOUBTFUL AND EXCLUDED TAXA

? = Doubtful taxa
# = Excluded taxa

# **Actidium pulchellum** Rick, Brotéria 4: 161. 1905
Typus.- In PACA (N. 22031). -Portugal, Torres Vedras, in foliis cujusdam arbusti mihi incogniti.

Chorology.- PRT: E (66,78).
Substrate.- Leaves of shrub.

Observations: The description of this species is doubtful, because the fruitbodies are star-shaped and the spores are filiform (60-75 x 1 mm) without septa (RICK, 1905), by these reasons its inclusion in the genus *Actidium* is erroneous. The study of the type material show that this is probably *Coccomyces delta* (Kunze) Sacc.

? **Mytilinidion limonii** (Thüm.) Sacc., Syll. Fung. 2: 800. 1883
≡ *Lophium limonii* Thüm., Instituto (Coimbra), Sér. 2, 28(8): 367. 1881

Chorology.- PRT: DL (67,76,77). Without locality (65).
Substrate.- *Citrus limon.*

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REFERENCES

Barr, M.E. (1992). Notes on the Lophiostomataceae (Pleosporales).Mycotaxon 45:191-221.
Bisby, G.R. (1932). The specimens of certain Hysteriales. Mycologia 24:304-329.
Checa, J. (1997). Annotated list of the Hysteriaceae (Dothideales, Ascomycotina) reported from the Iberian Peninsula and Balearic Islands. Mycotaxon 62: 349-374.
Chesters, C.G.C. & Bell, A. (1970). Studies in the Lophiostomataceae Sacc. Mycol. Pap. 120:1-55.

Crivelli, P.G. (1983). Ueber die heterogene Ascomyceten Gattung Pleospora Rabh.; Vorschlag für eine Auftelung. ADAG Administration & Druckk AG. Diss. ETH. Nr. 7318.

Eriksson, O.E. & Hawksworth, D.L. (1993). Outline of the Ascomycetes-1993. Syst. Ascom. 121:51-257.

Hawksworth, D.L., Kirk, P.M., Sutton, B.C. & Pegler,D.N. (1995). Ainswoth & Bisby's. Dictionary of the fungi. (8.ed.). CABI.

Holm, L. (1957). Études taxonomiques sur les Pléosporacées. Symb. Bot. Upsal. 14(3).1-188.

Holm, L. & Holm, K. (1988). Studies in the Lophiostomataceae with emphasis on the Swedish species. Symb. Bot. Upsal. 28(2):1-50.

Rick, J. (1905). Fungos dos arrededores de Torres Vedras. Brotéria, Sér. Bot. 4:159-163.

Shoemaker, R.A. (1984). Canadian and some extralimital Nodulosphaeria and Entodesmium. Can. J. Bot. 62:2730-2753.

Tellería, M.T. (1990). Annotated list of the Corticiaceae, sensu lato (Aphyllophorales, Basidiomycotina), for Peninsular Spain and Balearic Islands. Biblioth. Mycol. 135. 32:213-229.

Urríes, M.J. (1932). Datos sobre micromicetos de la provincia de Huesca. Bol. Soc. Esp. Hist. Nat. 32: 213-229.

Urríes, M.J. (1941). Datos para la flora española de micromicetos (segunda nota). Anales Jard. Bot. Madrid 1(1):59-78 [1940].

Zogg, H. (1962). Die Hysteriaceae s. str. und Lophiaceae. Beitr. Kryptogamenfl. Schweiz 11:1-190.

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THREE NEW SPECIES OF THE MELIOLACEAE FROM KERALA, INDIA

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Abstract

This paper gives an account of three species of the Meliolaceae collected in the state of Kerala. *Asteridiella antidesmaticola*, *Meliola glutae* and *M. tibigirica* are described in detail and illustrated.

Key words: Meliolaceae, new species, Kerala.

Introduction

The Western Ghats lie toward the western side of peninsular India, extending from the Tapti Valley of Gujarat in the north, southward to Kanniyakumari in Tamil Nadu, traversing the states of Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu. These Ghats are a mostly continuous hill range (except for the Palghat Gap) about 1600 kms in length, reaching altitudes of 500 to 1500 m, but ranging up to 2695 m at Anaimudi and 2637 m at Doddabetta. The annual rainfall ranges from 2350 mm to 7450 mm, with temperatures averaging 20-24° C. They slope steeply toward the Arabian Sea and slowly merge with the Deccan Plateau in the east.

Because of the favorable location, rainfall and temperature, vegetation flourishes in the region, with about 4000 taxa of flowering plants being represented (Nair & Daniel, 1986). This biologically rich area has not been surveyed systematically for the lower plant groups such as the bryophytes, algae, fungi, actinomycetes and bacteria, and may well be a store house for many life-saving, crop-saving and industrially valuable microorganisms.

With this in view, a systematic survey of the foliicolous, pathogenic microfungi occuring in the Peppara and Neyyar Wildlife Santuaries, located in the western slope of the Western Ghats in the Thiruvananthapuram District of Kerala State, has been initiated. This report concerns three undescribed species of the Meliolaceae; additional results will be forthcoming as the work is completed. Portions of the these collections have been deposited at the Tropical Botanic Garden, Thiruvananthapuram (TBGT).

1. ***Asteridiella antidesmaticola*** Hosagoudar and Abraham, sp. nov. Fig. 1

Coloniae epiphyllae, densae, crustosae, ad 1 mm diam, raro confluentes. Hyphae leniter anfractuae, opposite vel irregularite acuteque ramosae, laxe vel dense reticulatae, cellulae 19-48 x 4.5-7.5 μm. Hyphopodia alternata, antrorsa, subantrorsa vel patentia, 24-26 μm longa; cellula basali cylindracea vel cuneata, 7-12 μm longa; cellula apicali ovata, oblonga, globosa, integra vel angularia, 14.5-17 x 14-15 μm. Phialides producentes in hyphis distinctis, alternatis vel oppositis, ampullaceus, 16-24 x 4.5-7.5 μm. Perithecia dispersa, ad 160 μm diam; cellulae peritheciales indistinctae; ascosporae cylindraceae, 4-septatae, leniter constrictae ad septatae, 36-38.5 x 14.5-17 μm.

Colonies epiphyllous, dense, crustose, up to 1 mm diam, rarely confluent. Hyphae slightly crooked, branching opposite to irregular at acute angles, loosely to closely reticulate, cells 19-48 x 4.5-7.5 μm. Hyphopodia alternate, antrorse, subantrorse to spreading, 24-26 μm long; stalk cells cylindrical to cuneate, 7-12 μm long; head cells ovate, oblong, globose, entire to angular, 14.5-17 x 14-15 μm. Phialides borne on a separate mycelial branch, alternate to opposite, ampulliform, 16-24 x 4.5-7.5 μm. Perithecia scattered, up to 160 μm diam; perithecial cells not distinct; ascospores cylindrical, 4-septate, slightly constricted at the septa, 36-38.5 x 14.5-17 μm.

Holotype : On leaves of *Antidesma alexiteria* L. (Stilaginaceae), in the forest near Kombe, Meenmutty, Neyyar Wildlife Sanctuary, Thiruvananthapuram, Kerala, India. March 9, 1996. V. B. Hosagoudar. HCIO No. 42173.

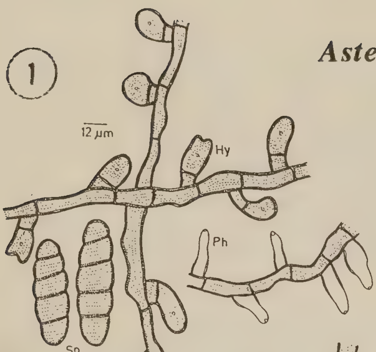
Asteridiella antidesmatis Hansf. is the only known species of the genus *Asteridiella* occuring on a member of the family Stilaginaceae (Hansford, 1961). The new species differs from it in having hyphopodia with entire head cells, phialides borne on a separate mycelial branch and in having smaller ascospores.

2. ***Meliola glutae*** Hosagoudar and Abraham, sp. nov. Fig. 2

Coloniae hypophyllae, tenues, crustosae, plerumque positae in maculae nigrae, ad 5 mm diam. Hyphae subrectae vel leniter anfractuae, irregulariter acuteque ramosae, laxe reticulatae, cellullae 24-29 x 4.5-7.5 μm. Hyphopodia alternata, recta vel curvula, antrorsa, patentia vel recurvula, 19-29 μm longa; cellula basali cylindracea vel cuneata, 7-10 μm longa; cellula apicali ovata, globosa, hamata, integra vel angularia, 12-19.5 x 12-17 μm. Phialides illis hyphopodiis commixta, alternata vel opposita, ampullacea, 24-26.5 x 6-8 μm. Setae myceliales simplices, rectae, raro geniculatae, setae myceliales obtusae ad apicem, setae juxta perithecia 2-3 dentatae ad apicem, ad 720 μm longae. Perithecia dispersa, ad 200 μm diam; ascosporae cylindraceae, 4-septatae, fortiter constrictae ad septatae, 52-56 x 21-24 μm.

Colonies hypophyllous, thin, crustose, often forming dark spots, up to 5 mm diam. Hyphae substraight to slightly crooked, branching irregular at acute angles, loosely reticulate, cells 24-29 x 4.5-7.5 μm. Hyphopodia alternate, straight to curved, antrorse, spreading to recurved, 19-29 μm long; stalk cells cylindrical to cuneate, 7-10 μm long; head cells ovate, globose, hamate, entire to angular, 12-19.5 x 12-17 μm. Phialides mixed with hyphopodia, alternate to opposite, ampulliform, 24-26.5 x 6-8 μm. Mycelial setae simple, straight, rarely genticulate, setae on mycelium obtuse at the tip, setae around perithecia 2-3 times dentate at the tip, up to 720 μm long. Perithecia scattered, up to 200 μm diam; ascospores cylindrical 4-septate, strongly constricted at the septa, 52-56 x 21-24 μm.

Holotype : On leaves of *Gluta travancorica* Bedd. (Anacardiaceae), in the forest near Kombe, Meenmutty, Neyyar Wildlife Sanctuary, Thiruvananthapuram, Kerala, India. March 12, 1996. V. B. Hosagoudar. HCIO No. 42160.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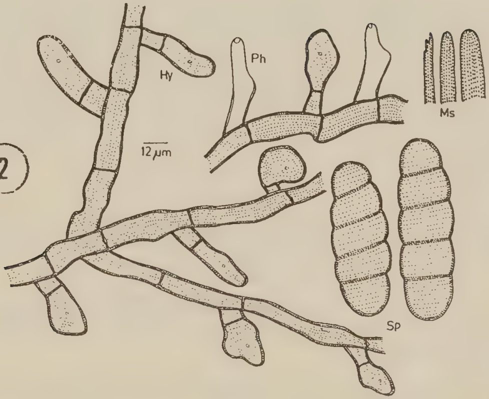
Asteridiella antidesmaticola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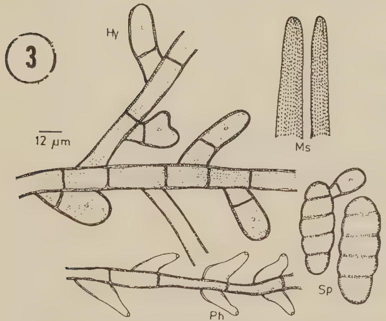
Meliola glutae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Meliola tibigirica

This species can be compared with *Meliolamangiferae* Earle but differs from it in having smaller hyphopodia and very few dentate setae around the perithecia.

3. ***Meliola tibigirica*** Hosagoudar and Abraham, sp. nov. Fig. 3

Coloniae amphigenae, raro caulicolae, densae, dispersae, ad 3 mm diam, plerumque confluentes. Hyphae rectae vel subrectae, alternate, opposite vel irregulariter acuteque ramosae, dense reticulatae, cellulae 12-31 x 7-8 μm. Hyphopodia alternata, recta vel curvula, antrorsa, 26-36 μm longa; cellula basali cylindracea vel cuneata, 9.5-17 μm longa; cellula apicali ovata, globosa, integra vel raro sublobata, 12-19.5 x 12-14.5 μm. Phialides producentes in hyphis separatis, alternatis, oppositis vel solitaritus, ampullaceus, 21-24.5 x 7-10 μm. Setae myceliales numerosae, dispersae, simplices, rectae, obtusae ad apicem, ad 625 μm longae. Perithecia dispersa, ad 155 μm diam; ascosporae cylindraceae vel leniter ellipsoideae, 4-septatae, constrictae ad septatae, plerumque rectae vel raro leniter curvulae, raro cellulae ad centro magniorae, 45-53 x 14.5-17 μm.

Colonies amphigenous, rarely on stem, dense, scattered, up to 3 mm diam, often confluent. Hyphae straight to substraight, branching alternate, opposite to irregular at acute angles, closely reticulate, cells 12-31 x 7-8 μm. Hyphopodia alternate, straight to curved, antrorse, 26-36 μm long; stalk cells cylindrical to cuneate, 9.5-17 μm long; head cells ovate, globose, entire to rarely sublobate 12-19.5 x 12-14.5 μm. Phialides borne on a separate mycelial branch, alternate, opposite to solitary, ampulliform, 21-24.5 x 7-10 μm. Mycelial setae numerous, scattered, simple, straight, obtuse at the tip, up to 625 μm long. Perithecia scattered, up to 155 μm diam; ascospores cylindrical to slightly ellopsoidal, 4-septate, constricted at the septa, mostly straight, rarely slightly curved, rarely central cell larger, 45-53 x 14.5-17 μm.

Holotype : On leaves of *Rhychospora corymbosa* (L.) Britt. (Cyperaceae), in the forest near Kombe, Meenmutty, Neyyar Wildlife Sanctuary, Thiruvananthapuram, Kerala, India. March 8, 1996. S. Shiburaj. HCIO No. 42170.

This species is close to *Meliola mapaniae* Yates (Hansford, 1961) but differs from it in having phialides borne on a separate mycelial branch, and numerous and obtuse.mycelial setae

This species is named after the institute TBGRI (Tropical Botanic Garden and Research Institute).

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References

Hansford, C. G. 1961. The Meliolineae, a monograph. *Sydowia Beih.* 2: 1-806.

Nair, N. C. and P. Daniel. 1986. The floristic diversity of the Western Ghats and its conservation: a review. *Proc. Indian Acad. Sci. Suppl.* 127-163.

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A NEW BOOK REVIEW EDITOR FOR MYCOTAXON

Eric H. C. McKenzie has accepted the position of Book Review Editor for *Mycotaxon*. Dr. McKenzie is a mycologist and curator of Herbarium PDD, Manaaki Whenua-Landcare Research, Auckland, New Zealand, a Crown Research Institute. He is the fourth Book Review Editor for *Mycotaxon*.

Grégoire L. Hennebert initiated the feature in volume one of the journal, and was succeeded by Linda M. Kohn and then David S. Hibbett. Through their efforts *Mycotaxon* readers have been informed of new or lesser known titles of interest to fungal taxonomists.

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Castañeda Ruíz, R. F., B. Kendrick, and J. Gené. Notes on conidial fungi. XIII. A new species of *Cladosporium* from Cuba, **63:** 183-187. 1997.

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Checa, J. Annotated list of the Lophiostomataceae and Mytilinidiaceae (Dothideales, Ascomycotina) reported from the Iberian Peninsula and Balearic Islands, **63:** 467-491. 1997.

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Corlett, Michael, S. A. Redhead, and C. E. Babcock. Corrigendum and indexes (fungus names, hosts and substrates) to *Fungi Canadenses* 1-330 (1973-1990), **63:** 87-130. 1997.

de Hoog, G. S., E. Guého, and M. Th. Smith. Nomenclatural notes on some arthroconidial yeasts, **63:** 345-347. 1997.

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Mercado Sierra, Angel, Gabriela Heredia Abarca, and Julio Mena Portales. Tropical hyphomycetes of Mexico I. New species of *Hemicorynespora, Piricauda* and*Rhinocladium,* **63:** 155-167. 1997.
Mohammed, C., *see* **Yuan and Mohammed**
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Moreno, G., J. L. Manjón, J. Diez, L. G. García-Montero, and G. Di Massimo. *Tuber pseudohimalayense* sp. nov. An Asiatic species commercialized in Spain, similar to the "Perigord" truffle, **63:** 217-224. 1997.
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Pérez Silva, Evangelina, and José Luis León de la Luz. Macromycetes of Baja California Sur, Mexico, **63:** 395-417. 1997.
Petersen, Ronald H. Mating systems in hymenomycetes: new reports and taxonomic implications, **63:** 225-259. 1997.
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